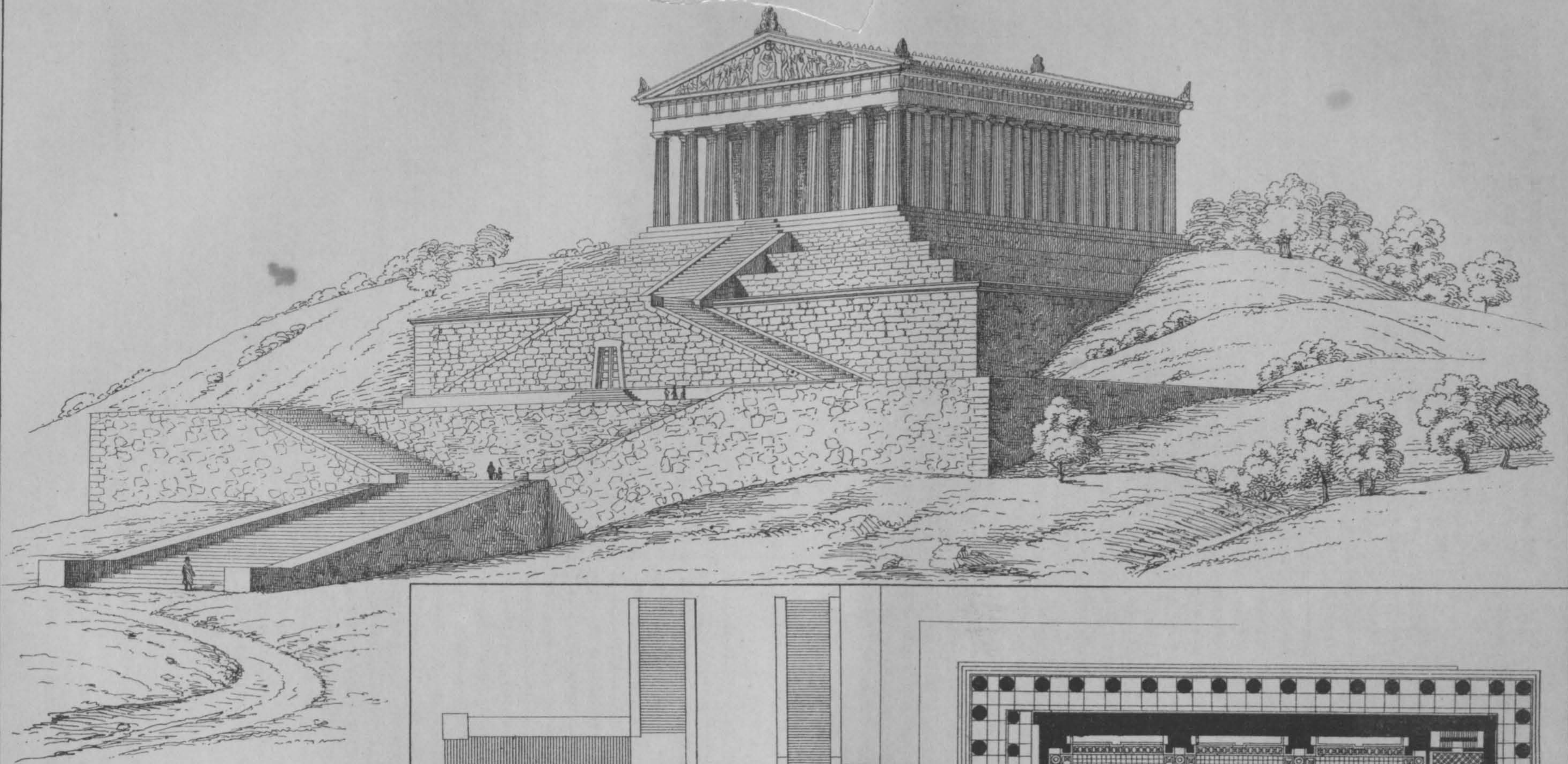
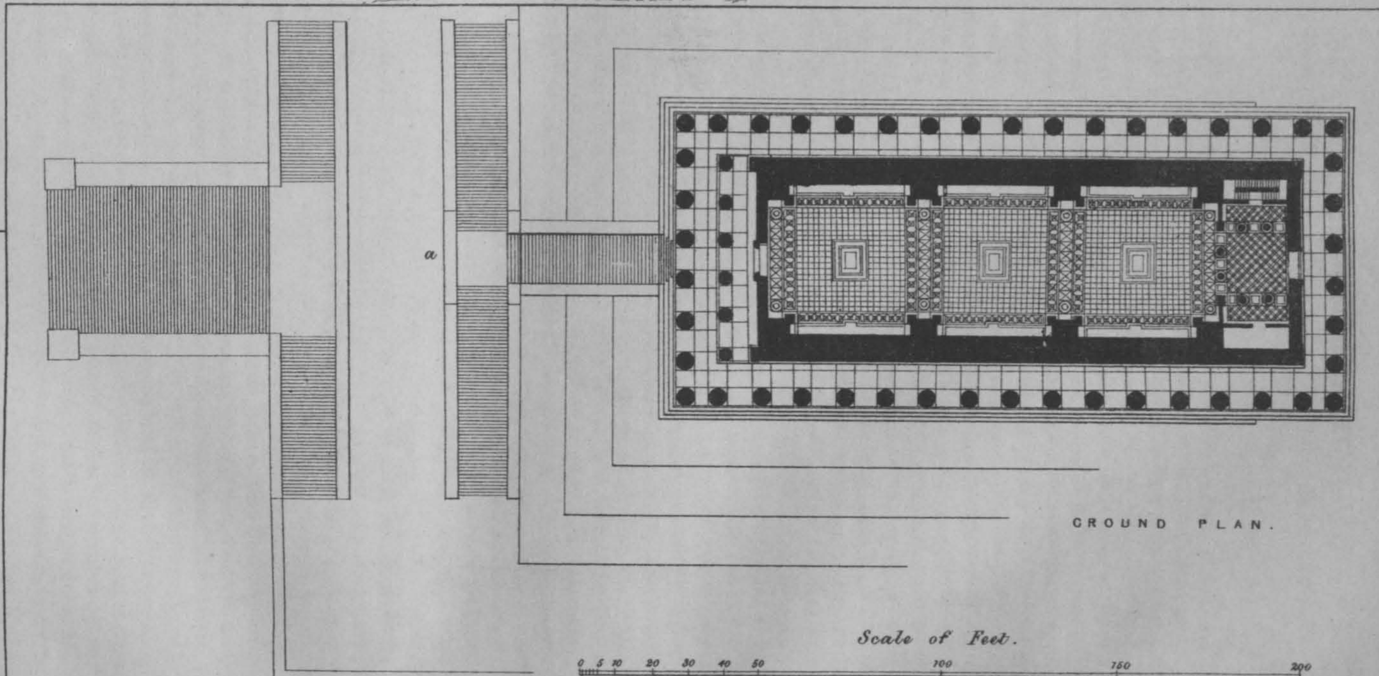


The WALHALLA.



J.R. Jobbins 3 Warwick Ct.

PLATE V.

J.R. Jobbins litho. Warwick C.^t

INTERIOR of the WALHALLA.

THE WALHALLA.

Description of the Walhalla, read at the Institute of British Architects,
BY JOHN WOOLLEY, FELLOW.
(With two Engravings, Plates IV and V.[1] *)*

THE idea of raising a monument to the great men of Germany originated with the present king of Bavaria. While he was Crown Prince, and only 20 years of age, he conceived the plan of raising a vast edifice for the reception of busts of illustrious men of every state in Germany, whether Bavarian, Prussian, or Austrian, without distinction, beginning from the earliest records of German history, and including princes, philosophers, warriors, poets, artists, and learned men,—all who might have distinguished themselves by their virtues or their genius. It was in 1804, according to the inscription upon the pavement of the temple, that this noble project was first contemplated by the prince; and though delayed and interrupted at that period, and for some years subsequently, by the disturbed state of his country, his design was never abandoned; but, conceived as it was in youthful ardour, it has been prosecuted with manly energy and constancy, and at length, in the summer of last year, received completion in the magnificent edifice, the Walhalla, which now adorns the banks of the Danube at Ratisbon.

The character given to the building by its mythological appellation, is carried out by the sculpture which adorns the interior, and Klenze has made this "voice of architecture," as Mr. Cockerell terms it, an organ to awaken among artists an interest in a mythology which has been most undeservedly neglected. The adaptation of the national fables of the early Germans to a building so entirely national in its conception as the Walhalla, is most appropriate, and certainly the most original feature of the design. Except merely to state that the name received the consideration of many learned men, the architect has offered no remark upon this employment of the Gothic mythology: probably because the subject is much more familiar to Germans than to Englishmen. For this reason I shall offer no apology for prefacing the description of the Walhalla by a brief account of its mythological prototype, and by a few words upon the northern mythology.

The study of mythology has always held a foremost place in modern education, because the knowledge of the religion professed by the early inhabitants of a country is so essential to the understanding the works of ancient authors, and in order to aid the investigations of the customs and monuments of antiquity. But why the Paganism—called, by way of excellence, classic—should have engrossed so much attention, to the exclusion of a mythology which has so much more claim upon our national sympathy, has been frequently asked, but remains still to be answered. As long ago as the year 1800, the University of Copenhagen considered the matter of sufficient importance to give, as the subject of a prize essay, the question, "Whether the Northern mythology is worthy of equal rank with the Grecian." The question was decided in the affirmative by all the candidates, and Müller, Ohlenschläger, Dalins, and others in their subsequent illustrations of the subject, have fully justified their decision. Without discussing the degree of merit to which each is entitled, it will be readily granted that the Scandinavian mythology, independent of any intrinsic beauty it may possess, has this one great claim upon our attention over the Paganism of Greece and Rome: namely, that we, as well as the other countries of Northern Europe, may esteem these magnificent superstitions as having been the religion of our forefathers; for while the worship prescribed by the Greeks extended itself in Europe no farther than Greece and Italy, the major part of Gaul, Scandinavia, Germany, and Britain, cultivated a mythology and literature peculiarly their own,—a mythology which gives a striking picture of our northern ancestors, and to which our customs, antiquities, and language make perpetual reference.

Upon the conquest of England by the Saxons, the ancient Britons were driven to seek refuge, the principal part of them in that part of France then called Armorica, to which they gave the name of Brittany, and the few that remained in this country in the remote corners of Wales and Cornwall. With their language and their customs the victorious Saxons introduced their fables and their sagas, and the worship of Odin was established throughout the heptarchy.

Hume speaks of the religion of the Saxons as "consisting of superstitions of the grossest and most barbarous kind, as one of which little is known, and which, compared with the systematic and politic institutions of the Druids, made little impression upon its votaries, and which accordingly gave place to the new doctrine" (of Christianity). This is not true; the worship of Odin was one of all others calculated to dazzle and captivate the imagination of a warlike race like the Northmen; and that the laws of that great conqueror took deep root wherever they were propagated,—that is to say, throughout the north,—is beyond all question. Christianity eventually triumphed, not easily, or because it met with no opposition, as Hume supposes; but because truth must prevail over superstition and error. But even Christianity and the lapse of more than eleven centuries have failed to eradicate altogether the traces of this worship: of which fact the names of the days of the week in almost all the languages of Northern Europe is the most familiar instance. The rites of the Druids were the most terrible ever known: their barbarous wicker idol immolations were unknown among the Gothic nations. And another principal feature of their institutions was the profound ignorance which it was the policy of their priests to maintain; for they most carefully concealed their doctrines from the vulgar, forbidding that they should ever be committed to writing: and on this account they had not so much as even an alphabet of their own. The institutions of Odin were entirely the reverse of this. No barbarous people were ever so addicted to writing, as appears from the innumerable quantity of Runic inscriptions scattered all over the north, not excepting England and Scotland. The invention of letters was considered the offspring of Divine intellect, and ascribed to their chief deity; and the characters themselves were supposed to be possessed of magic virtues. The Edda, the Voluspa, and the sagas of this heathen period are still preserved, and are written in a language which is the parent of all the Gothic dialects. The Havamaal, or sublime discourse, ascribed to Odin himself, in which he has delivered admirable precepts to his followers, is the only thing of the kind in existence, and contains profound maxims of wisdom:

> "Which skalds of old have spoken since, in lays of Havamaal:
> From race to race descended deep, those sayings fraught with doom,
> And Norway still reveres the same, as voices from the tomb."

The religion of Odin carried with it an innumerable quantity of mythic poems and sagas, and the skalds, or scops, who sung and chronicled these traditions, thus possessed of a mythology so propitious to poetic fiction and ornament, were celebrated throughout the north of Europe: they visited other countries, resided amidst the splendour of courts, and were enriched and caressed by the greatest monarchs of their time. The dawn of northern literature—the only literature which Europe can boast anterior to the adoption of Christianity—is, in short, inseparably connected with the northern superstitions, and the sagas in which they are preserved, must ever remain the earliest monuments of Gothic intellect. So rich a mine has not been neglected by modern writers among the Danes, Swedes, and Germans; many a beautiful creation of genius owes its existence to this source, as the German reader well knows, and the works of Gray, Cottle, Sayers, and especially Herbert, prove that the English are not insensible of the beauties of the northern mythology.[1] But for the artist, to whom these remarks are addressed, it remains an almost unexplored region of magnificent and poetic fable, which may challenge competition with any which the ingenuity of man has invented. As an instance, it would be impossible to select a more poetical creation of fiction than that of the Walkyriae,—those beautiful, but terrible emissaries of Odin, seen by the dying Scandinavian hero only during his last agonies upon the field of battle, and there upholding his courage

[1] [We are obliged to postpone Plate V, a perspective view of the interior, until next month.—ED.]

* Among these should be mentioned also the translations of Tegneris Frithoff, especially that by Mr. Latham.

to the last, and cheering the dark hour of death by visions of the Walhalla, to which they were come to conduct him.

These beautiful and warlike maidens play an important part in the paradise of heroes, and have been accordingly introduced by Klenze in the building under consideration. Their name, Walkyriae from two Icelandic words, signifies choosers of the slain, as Walhalla means the hall of the slain. Their office was to receive the souls of those warriors who were deemed by Odin worthy of immortal reward, and conduct them to his palace of Walhalla. Led by his beautiful guide, the shade of the hero passes over the bridge of the gods, the rainbow, called Bifrost, which is guarded by the sentinel Heimdal, and they enter the celestial city Asgard, surrounded by ever blooming trees, and full of gold and silver palaces, the mansions of the gods of the Edda. Above this city lies Gladsheim: and here, surrounded by a grove whose trees bear golden leaves and fruit, is situated the promised Walhalla. The hero and his guide approach the western gate, upon which the magic bolt Walgrind, which excludes all unconsecrated souls, falls, and his future residence lies before the hero in all its glittering splendour: gold and silver, brightly polished shields, armour, and weapons, and all the paraphernalia of barbarous warfare, appears on all sides. The Einheriar,—the name given to the future inhabitant of this glorious abode,—upon his entrance, is presented by his guardian Walkyria with his installation cup of mead, Iduna, the goddess of youth, offers him the apples of immortality, and he is at once recognised by his former companions in arms, who have gone to Walhalla before him, with loud shouts of greeting,—"Welcome, Einheriar! enjoy peace and drink mead for ever with the gods!" the future life of these heroes, notwithstanding this reception, is neither an idle or peaceable one. Fighting was an indispensable amusement with our forefathers even in the abodes of bliss. Fighting was their business and pleasure upon earth, and, according to all savage ideas of a future state, they expected to repeat again their earthly pleasures in heaven. Hence arose the custom among the Scandinavians when a chief fell gloriously in battle, to burn with him upon the pyre his armour, sword, and war horse, and whatever else he held most dear. His dependents and friends frequently made it a point of honor to die with their leader, and attend on his shade in the palace of Odin. In the tomb of King Chilperic were found his arms and the bones of the horse on which he supposed he should be presented to the warrior god in Walhalla. A singular instance of this custom has been recently discovered upon opening three tumuli near East Ilsley in Berkshire. In the graves were found skeletons of gigantic persons, together with warlike weapons, rude articles of military equipments, and the bones of animals, probably horses. These persons had evidently fallen in battle, the skulls being fractured, and an iron javelin head being firmly fixed in one of the hip bones.

The pastimes in Walhalla were therefore in accordance with this superstition. In the morning, at the crowing of the golden cock Fialar, the heroes arise with one accord, buckle on their armour and weapons, mount their war steeds, and sally out of the 540 gates of the Walhalla.

"Fünfhundert Thüren und noch vierzig
Glanb'ich dass in Walhall sind:—
Alle Einheriar in Odin's Gehege
Hanen sich jeden Tag;
Tod kiesen sie und reiten vom Kampf,
Trinken Bier mit den Asen und speisen Sährimner,
Und sitzen einträchtig zusammen."

—*Rüh's Edda.*

They ride to a mighty plain called Odinstun, and here they fight together with all the fury of their mortal days, performing miracles of bravery until the god Heimdal sounds his horn, upon which their wounds are miraculously healed, and they return amicably to the banquet in Walhalla, the bravest of the day being rewarded with the most distinguished places at the board. Their food consists of swine's flesh, from the hog Sährimner, which is never consumed, and mead, or hydromel, is supplied by the beautiful Walkyriae, whose duty it is to attend upon them, the gods and Odin himself being present at the banquet.

It should be observed, that warriors of mean birth, and slaves, though dying bravely and in battle, were not admitted to the mansion of Odin; but were received into the palace of Thor, in Bilskirner: noble women were assigned a residence in Folkvang, the palace of the goddess Freia. The unwarlike, and those who had the misfortune to live all the days of their lives,—a calamity which the Scandinavians avoided by voluntarily destroying themselves,—were condemned to an abode in Niflheim, the icy domain of the infernal goddess Hela, from whose name is derived our word hell.

These are the principal features of that portion of the northern mythology which has furnished an appropriate name for a monument to the honor of the illustrious sons of Germany. It might be wished that the architecture of this splendid building had shared in the spirit of nationality of which in all other respects it is so characteristic; or at least that it had been more original in design. But as far as regards the exterior, it can claim the merit only of being an excellent restoration of the Parthenon: the architect has made more than ample atonement for rejecting the mythology of the Greeks by most scrupulously following their architectural model. For this want of invention he seems quite willing to hold himself responsible, by stating that, though the Grecian Doric order was recommended, he was left to the free exercise of his judgment in every other respct. I am, notwithstanding, inclined to suspect that the hint given to the competing architects in the original instructions—to the effect, that an imitation of some approved model of antiquity would be preferred to a less beautiful, though more original invention—influenced him more than he chooses to confess.

The enormous substructure of masonry and large "step-like plinths" upon which the temple is elevated appears to be an injudicious arrangement: it has the effect of making the principal object, the building itself, appear insignificant compared with its subordinate pedestal. The effect must not be judged, however, from a geometrical elevation; for it must be remembered that the building stands upon a considerable eminence, and that the consequent forshortening, when seen from below, must in a great measure obviate this objection.

The arrangement of the interior is very skilful, and in many respects original. The task of introducing a method of roofing unknown to the Greeks, but designed in the spirit of their architecture, was a difficult one, and is well overcome. The roof is of cast iron, of which the construction is visible, leaving open spaces glazed for the admission of light, and by means of sculpture rendered highly ornamental.

The division of the hall by the projecting masses, or wings, which originate in the necessary support of the roof, is a disposition which produces animation and a play of light and shade, and also increases the apparent extent of the building. These wings boldly projecting from the side walls, break the monotony of the simple parallelogram form of the plan, and always conceal a portion of the busts which occupy the lower range of walls, and which, from their great number and similarity, would otherwise have become wearisome. The upper portion of the side walls is visible the entire length, interrupted only by the beautiful Walkyren caryatides which form the principal ornament of the interior, and upon which the eye of the spectator first rests.

The temple, exclusive of the substructure, incloses a space of 234 ft. in length and 107 ft. in breadth, surrounded by 52 Doric columns 31 ft. high and 5 ft. 10 in. diameter. The internal length, including the opisthodomus, is 171 ft., the breadth 92 ft., and the greatest height 53 ft. 5 in. Height of the lower order, 28 ft. 5 in.; the upper order, 17 ft. 5 in.; and the caryatides, 10 ft. 5 in.;—height of the temple outside to the summit of the pediment, 61 ft. The substructure is 106 ft. high, 236 ft. in breadth, and 425 ft. in depth. From the level of the Danube to the summit of the temple is 304 ft.

The following description is abridged from the work published by the architect, Leo von Klenze:—

"In February of the year 1814 there appeared in the public papers an invitation to German architects, to prepare designs for the monument which his Royal Highness the Crown Prince of Bavaria proposed erecting to the great men of Germany. The plans produced by this invitation were not satisfactory to his Royal Highness, and I was commissioned to prepare the drawings which have formed the basis of the present design.

"Ratisbon,—a city famous in the history of Germany and Bavaria, and one of the uniting points of the grand roads of Germany, situated upon one of the principal rivers, and in a charming country diversified by valley and mountain, and in a mild climate favourable to building, —Ratisbon was the place chosen by the king as the site of the future Walhalla.

"The 18th October, 1830, the anniversary of that battle which freed Germany from a foreign yoke, was the day appointed for laying the first stone of the edifice. The ceremony was performed by the king in person, and an eloquent oration was pronounced by Edward von Schenck. 'Since civilization and education have been naturalized in Germany,' said he, 'many glorious buildings have been erected; for centuries together has the most persevering art been often employed upon the perfection of a single cathedral. Our country is filled with churches, palaces, fortresses, and castles, and modern times have seen the erection of halls and temples not unworthy of the very father-land of the arts. Statues also, and monuments have been raised to individuals; but since the earliest period of our history Germany has never till now erected an universal monument to her mighty sons. The project of erecting such a monument was reserved for King Louis of Bavaria, and never lived a monarch more worthy to carry such a design into execution.'

"'Let us now,' continued von Schenck, 'look with prophetic eye to the completion of the Walhalla, and contemplate the building as it will one day appear upon the eminence whereon we now stand. What a prospect for the traveller who approaches from the shores of the Danube! Upon the summit of this mountain he will behold a mighty temple of white marble, a hall worthy of the glorified heroes, resting upon mighty Doric columns, embanked by cyclopeian walls and terraces, and approached by extensive flights of stone steps.

"'Having ascended these steps, the sculptured pediment above reminds him of the conquest of the Romans by the Cherusei, and other early battles of the German people. He enters the temple, and his first glance falls upon a sculptured frieze which surrounds the walls, representing the religion, customs, battles, and commerce of the aborigines of Germany. Beneath this frieze, and all around him, he beholds the busts and glorious names of those men who have immortalized our father-land in every braach of art and science, and on every public occasion. The series of these great men commences with those ancient heroes whose primordial efforts broke the mighty power of Rome: to them follows the race of Pepin of Heristhall, the line of noble and mighty emperors of Saxon and Frankish race, the Hohenstaufen, and the race of Habsburger.

"'The line of emperors is closed by those great and good princes who have governed in their own separate countries, or in foreign lands,—such as Otho and Maximillian of Bavaria, Amalia of Hessen, William of Orange, Frederick of Prussia, &c.

"'These monarchs are surrounded by the great men who have been their contemporaries, and who have lived and died for faith and truth, for fame and freedom, or for science and art. Heroes from the Cherusker Hermann, who conquered the Romans, down to Schwartzenberg and Blucher; holy men, like Nicholas von der Flue and Thomas à Kempis; philosophers, as Leibnitz and Haller; Germany's early poets, from the author of the renowned Nibelungen Lied down to Schiller; (long may the bust of Goëthe remain in the Hall of Expectation[2]) the heroes of plastic art, from the old masters down to Mengs; and, last of all, the mighty Dioscuri of German melody, from Gluck to Mozart.'

"'I can believe,' concluded Von Shenck, 'that the spirits of these great men are now at this auspicious moment hovering around us in gratitude to the noble king who raises this monument to their merits. Their blessing will not be in vain: it is joined to that of Heaven, and descends already upon this building.'

"'While in many other—alas! also German—states, sedition and mistrust threaten to loosen the holy bands between prince and people, here, in Bavaria, stands her king: happy, because he diffuses happiness and prosperity, mighty in the love of his people, justly estimating his high calling, and with conscious power steadily fulfilling it. And thus he lays the foundation stone of a monument to German greatness and German truth.'"

On the conclusion of this oration, the king, standing beneath a baldaquin, supported by columns and surmounted by a statue of Germany, proceeded to lay the first stone of the Walhalla, and the building was commenced in the spring of 1831.

The first large division of the terrace is of Pelasgic construction, and of polygonal blocks of a marble-like limestone; the second division, and likewise the three large step-like landings below the temple, are of the same stone, and formed of regular blocks, but of unequal height and length, as is found in many buildings of the Greeks,—as in the walls of Kalidon, and also in the Theatre of Marcellus in Rome. The columns are 5 ft. 10 in. in diameter, and formed in eleven blocks.

The severe style of the exterior architecture is relieved by the sculpture in the pediments, consisting of highly relieved groups in white marble, by the hand of Schwanthaler, from designs made by the king. The first illustrates the battle in Teutoburger Walde, under the victorious Armenius: the second represents Germany, to whom, after the catastrophe of 1813-14, the representatives of the united forces are presenting the lost provinces.[3]

The site was so chosen that the south end of the temple should present the principal entrance and access for those on foot. In ascending, by means of the different steps and terraces, first to the right and then to the left, the building and prospects of the distant country are presented to the visitor under various and continually changing points of view. Having arrived by 140 steps at the second terrace, a bronze door is seen, which leads to an arched chamber. This chamber is termed the Hall of Expectation, and is intended for the reception of busts of great men still living, from whence, when the occasion arrives, they are removed into the Walhalla itself. Two other flights of steps lead to the pronaos and principal entrance of the temple.

The arrangement of the interior demanded all possible space for the reception of the busts, and their proper distribution was a leading feature of the design. It was necessary that the busts should be all of equal size, and of the Greek therm form; and also, in order to typify the universal equality of all in Elysium, that they should be placed in rows according to their dates only, without individual distinction.

It was then essential that the monotony of the *coup d'œil* of so many similar sized heads should be got rid of. The construction of the roof, which of course could not be left open like the ancient hypethral temples, and which therefore required supporting beams, sustained by four projecting masses from each longitudinal wall so as to lessen their span: this form offered the best means of avoiding the objectionable repetition; and it was thus attained, namely, that in a general view along the hall, a large proportion of the busts would be always concealed from the spectator by the projecting architectural masses. At the extreme end is a large gallery, and in each longitudinal wall a passage introduced, both which during an inauguration or other ceremony, serve for the accommodation of spectators. In designing the building, the architect always had in view the celebration of some solemn and poetic ceremony, as for instance, that certain pe-

"[2] Goëthe has passed the ordeal which entitles the hero to admission within the halls of Walhalla; his bust will now be found among the best.—T.

[3] Professor Rauch made the original model for this sculpture to a small scale. The execution of it was afterwards entrusted to Schwanthaler, who was then rising into fame. He remodelled the design, and deserves the credit of the entire work, which is of the highest order.

riodical national associations should be held, having for a principal object, the admission of a new bust, and the solemn inauguration of a new hero to the halls of the Walhalla. On such an occasion a processional train would ascend the steps to the first terrace. Here the inaugural bust would be taken from the Hall of Expectation, which would be appropriately decorated for the occasion, and from thence be borne in procession to the next terrace, and so carried into the temple. Upon opening the great bronze doors the procession would be received by a chorus of singers, who would remain unseen in the gallery. Spectators would be permitted only in the gallery and passages, and the hall remain consequently quite free for the train, which would proceed in choragic order to the place appointed for the reception of the bust.

It was important that the interior decoration should tend to promote in the spectator the frame of mind which the foregoing ceremony had awakened, and therefore it was the desire of the accomplished founder of the Walhalla, that the aid of rich descriptive sculpture and ornament should be called in as the most effective means of so doing. In the mythology of our forefathers the Walkyriae were beautiful maidens, whose duty it was to bear dying heroes from the field of battle to the palace of Odin, there to be entertained with never-ending banquets, and to dwell for ever in the paradise of the valiant.

Statues of these beautiful companions of the beatified German heroes, have been employed as caryatides, to avoid the multiplication of severe architectural forms, which are apt to produce mechanical plainness, and also, in order to relieve the monotony produced by so large a number of busts. These Walkyren caryatides, sculptured in marble by L. Schwanthaler, are habited, as near as is known, in the ancient German costume, and are employed to support the cornice and roof. The heroes of the Walhalla are necessarily divided into two classes, namely, those who from the want of existing portraits are recorded only by name, and those of whom busts are really extant. To the first of these is allotted the upper division of the inner compartments of the walls, and their names are inscribed in the spaces between the fourteen caryatides. The busts in a double row, partly upon a continued pedestal, partly upon projecting marble bearers, are divided into six classes, over each of which presides a female therm-shaped statue, sculptured by Rauch, and having reference to the class over which she presides.

In order to complete the allegorical sculpture, the interior pediments formed by the horizontal beams, and the sloping roof, are enriched by three sculptured bas-reliefs, in which are represented the three principal epochs of the northern mythology. In the first is seen the giant Ymer, born of the moisture engendered by the hot wind from Muspelheim and the cold mists from Nifelheim, and from his shoulders spring the first human beings, Askar and Embla. Near him are the Lord of Muspelheim, Surtur the god of light and warmth, and Hela the goddess of Nifelheim. Foliage of the ash and elm [4] fill up the angles of the pediment. In the second pediment appear the principal inhabitants of Asgard; Odin with his spear Gugner, and Frigga with her golden spindle, seated upon their throne Lidskjolf; on the right is Thor with his terrible hammer Miölner, striking the Roman eagle to fragments, and Baldur the youthful god of Eloquence. On the left Braga the god of wisdom and poetry with his goddess Iduna, who, like the Greek Hebe in Olympus, presents the heroes of the Walhalla with the golden apples of immortality. The ravens of Odin fill up the angles. The centre of the third pediment is filled with the mighty ash tree Ydrasil, on the summit of which the eagle of Odin spreads his wings. Beneath the roots flows the fountain of wisdom, with which the tree is watered by the three Nornies. In the angles are the squirrels Rotatoskr.

Beneath this and between the upper and lower orders, is introduced a large bas-relief in eight divisions, which, according to the command of the royal founder of the Walhalla, illustrates the history of the German nation from its earliest period to the introduction of Christianity, and was designed and executed in white marble by Martin von Wagner in Rome. This admirable work, 224 ft. in length and 3 ft. 6 in. high, embraces the following eight principal events. 1st. The peopling of Germany by settlers from the east and the Caucasian countries. A mighty train, in long procession, of wild but beautiful forms, preceded by warriors, followed by their wives and children, and closed by shepherds, are represented passing the river Ister, and engaged in subduing the bear and wild boar, the sole inhabitants of the forests of Germany. In the second division is represented the religion and occupations of our ancestors. In the midst a religious ceremony is being solemnized under a large oak, and horses are being offered in sacrifice. Bards are chaunting the mysteries of the religious rites; and a troop of young warriors is impatiently awaiting the completion of their shields, which an artist is employed in decorating. The third division represents the political and commercial doings of our ancestors; the choice of a leader, the first council of the chosen king with his people, and the intercourse and commerce of the Phœnicians with the northern nations. In the 4th, 5th, and 6th, are represented the contests between the Germans and the Roman empire. In the 7th, the conquest of Rome by Alaric; and the introduction of Christianity by the fervent preaching of the holy Boniface, in the 8th division, concludes the bas-relief.

Respecting the ornament employed, it may be remarked, that without abandoning the long sanctioned Greek contour of form, the architect has employed foliage of German growth, assimilating it as far as possible with the Greek character.

As the adoption of classical architecture was expressly enjoined in the instructions for the edifice, it became necessary to follow what is believed to have been the practice of the Greeks, and unite the charm of colour to that of form. But the architect considers that the striking means which the Greeks employed to distinguish the outlines of their mouldings and members, rendered beautiful and necessary beneath the brilliant skies of Greece, on account of the clearness and light of their atmosphere, is not admissible on external architecture in a northern climate. The interior lithochromic decoration, is as follows: In the ceiling, those parts of the metal construction which are visible, are entirely gilt. The coffers of the ceiling, as well as the soffit of the beams, are coloured azure, and ornamented with stars of white gold or platina, with which, also, all rosettes, screw heads, and fir cones used in the construction are covered. The mouldings of the coffers and panels are likewise gilt and ornamented with coloured foliage. The sculpture and ornamental foliage which fill up the pediment shaped supports of the roof, are pierced and open, and of light form, that they may not appear to overload this essential part of the construction. They are partly of white and gold, and partly coloured after the manner of classic sculpture. The carved members of the cornice of the upper order, which is of white veined marble, is also partly gilt and partly coloured. The frieze is azure, with oak wreaths of bronze gilt. The upper division of the walls is of a reddish brown marble, from the quarries of Oberfranken: the inscription tablets of white marble, the letters of gilt bronze. The Walkyren caryatides of marble of the Danube are entirely but very faintly coloured. The parts representing flesh are ivory colour, the hair fair brown, the bear skin mantle entirely gilt, the upper dress bright violet, the under robe white. The plinth upon which the figures stand is of a warm grey Lumachelli marble; the entire entablature, and the long bas-relief, in the frieze, is of white marble, part from Schlanders, part from Carrara. The carved architrave and cornice are brought out in colour and gold, the relief quite white, and the ground of the ornaments in the frieze azure. The lower division of the principal walls, as well as the pilasters and shafts of the columns, are of brownish red marble from Admet, resembling the antique African. The caps and bases of the columns and pilasters are of white marble, ornamented with colour and gold. The carved bearers of the busts, the busts themselves, and the six presiding statues, together with all cantilevers and seats constituting the furniture of the hall, are of white marble without colour or gilding. As the busts could not with propriety have been coloured, it would have been prejudicial to them to have employed gilding or colouring in the sculpture of which th orm a

[4] These were sacred trees.

part. The continued pedestal upon which the first row of busts stands, is of a beautiful yellow marble, from Weltenburg, on the Danube; the plinth is white. The architraves of the doors and windows are of white marble, with ornaments of colour and gold. The doors, plated with bronze externally, are towards the interior, of maple, with studs, and inlaying of bright red amazanth wood.

The floor consists of a variety of marbles, following in pattern the general plan of the interior, and was worked and polished in the manufactory at Tegernsee. In the centre fields are three tablets, upon which, in black letters, upon a white ground, are the following inscriptions: "Projected in January, 1806; commenced October 18th, 1830; finished October 18th, 1842."

Inscriptions on the Tablets.

Herrmann, Conqueror of the Romans	21
Marobod, Chief of the Markomanni	40
Velleda, Prophetess	65
Claudius Civilis, Leader of the Batavians	100
Herrmannrich, King of the east Goths	375
Ulphilas, Bishop	380
Friediga, Leader of the west Goths	380
Alaric, King of the west Goths	410
Ataulf, ditto	415
Theodorich, ditto	451
Horsa, Conqueror of Britain	451
Genserich, King of the Vandals	477
Hengist, Conqueror of Britain	480
Odoaker, King of the Herulii and Rugii	497
Klodwig, King of the Franks	511
Theodrich, King of the east Goths	526
Totila, ditto	552
Alboin, King of the Lombards	573
Theutelinde, Queen of the Lombards	626
Emeran the Holy	680
Pipin of Heristall, Duke of Austrasia	714
Beda the Venerable, Abbot and Historian	735
Willibrod the Holy, first Bishop of Utrecht	739
Charles, Duke and Prince of the Franks	741
Bonifacius the Holy, Archbishop of Mainz	755
Pipin the Short, King of France	768
Wedekind, Leader of the Saxons	800
Paul Warnerfied, Historian	800
Alcuin, Abbot and Philosopher	804
Egbert, King of England	810
Charles the Great, Emperor (Charlemagne)	814
Eginhard, Historian	839
Rhabanus Maurus, Bishop and Philosopher	856
Arnulph, Emperor	900
Alfred the Great, King of England	900
Otto the Enlightened, Bishop of Saxony	912
Arnulph, Duke of Bavaria	937
Machthildis the Holy, Queen of Germany	968
Roswitha, Poetess	1000
Bernward the Holy, Bishop of Hildesheim	1022
Heirbert, Archbishop of Cologne	1028
Henry III, Emperor	1056
Lambrecht of Aschaffenburg, Historian	1077
Otto the Holy, Bishop of Bamberg	1139
Otto, Bishop of Freysing, Historian	1158
Hildegard the Holy, Abbess	1179
Otto the Great of Wittlesbach	1183
Engelbert the Holy, Archbishop of Cologne	1225
The Poet of Nibelunger Lied	
Walther of the Vogelweide, Minnesanger	1230
Elizabeth the Holy, Landgravine of Thüringen	1231
Leopold VII the Glorious, Duke of Austria	1234
Hermann of Salza, Master of the Teutonic Order	1240
Wolfram of Eschenback, Minnesänger	1251
The Architect of the Cathedral of Cologne	
Arnold of Thurn, the Founder of the Rhenish League	1264
Albertus Magnus, Bishop of Regensburg	1280
Walther Fürst, Werner Stauffacher, Arnold of Meshthal, The three men of Rütli	
Friedrick the Handsome of Austria	1330
Bruno of Warendop, Hanseatic Leader	1369
Arnold Strutthahn of Winkelried, Knight of Unterwalden	1386
Wilhelm of Cologne, Painter	1388
Hadrian of Bubenberg	1479
Peter Henlein, Inventor of Watches	1540

List of Busts at present placed in the Walhalla.

A catalogue of the individuals who have, in the first instance, been selected as worthy representatives of the genius of the German nation, will doubtless possess interest for many, nor the less on account of its indicating a very different estimate of worth and celebrity, from what would be looked for by ourselves. While many of the characters that have been selected for such honour, are scarcely known at all in this country, others who are here looked upon as first-rate German celebrities, do not appear. It is true not much more than half the intended number of busts have yet been executed, but those which remain to be added, are exceedingly few in comparison with the host of claimants for distinction. Among artists, Schinkel will almost of certainty be elected; as to Klenze, even when the time shall arrive for his being admitted into the company of illustrious worthies, such compliment may be deemed superfluous in his case, inasmuch as the Walhalla itself constitutes a sufficient monument of his talents and his fame.

	Date of Death.	Sculptor.	Date of Bust.
Heinrich der Finkler, King	936	Schadow	1821
Otto der Grosse, Emperor	973	Ditto	1821
Konrad II, Emperor	1039	Ditto	1810
Friedrich I. der Rothbart (Barbarossa) Emperor	1190	Schwanthaler	1835
Heinrich der Löwe	1190	Schadow	1821
Friedrich II, Emperor	1250	Ditto	1821
Rudolph von Hapsburg, King	1291		
Erwin von Steinbach (architect of Strasburg Cathedral)	1318		
Eberhard, Duke of Würtemberg	1445		
Joh. Guttenberg, inventor of printing	1467		
Joh. von Eyck, painter	1475	Rauch	1834
Friedrich der Siegreiche	1476	Lossow	1842
J. Muller (Regiomontanus)	1476		
Nikolaus von der Flue	1487	Tieck	1814
Hans Hemling, painter	1500	Woldeck	1841
J. von Dalberg, Bishop of Worms	1503	J. Henmann	1840
Berthold von Henneberg	1504	Mayr	1824
Hans von Hallwyl	1504	Christen	1812
Maximilian I, Emperor	1519	Kauffmann	1801
Reuchlin	1522	Imhof	1835
Franz von Sikingen	1523	Boudel	1823
Ulrich von Hutten	1523	Kirchmaier	1811
Albert Dürer, artist	1528	Rauch	1837
Georg von Freunsberg, field officer	1528	Widnmann	1841
Peter Visscher, the elder, artist	1530	C. Muller	1831
J. Turmayr, historian	1534	Horchler	1841
Walter von Plettenberg	1535	Schwanthaler	1831
Erasmus	1536	Tieck	1813
Theophrastus von Hohenheim (medical)	1541	Wolf	1827
Kopernicus, astronomer	1543	Schadow	1817
Hans Holbein, artist	1554		
Karl von Kaiser	1558	Schwanthaler	1841
Christopher, Duke of Würtemberg	1568	Bissen	1831
Ægidius Tchudi, historian	1572	Tieck	1817
William, Prince of Orange	1584	Ditto	1815
Augustus I, Elector of Saxony	1586	Ritschel	1840
Jul. Echter von Mespelbrunn, Bishop of Wurrburg	1617	Scholl	1840
Maurice, Prince of Orange	1625	Tieck	1814
Kepler, astronomer	1630	Schöpf	1842
Wallenstein, warrior	1634	Tieck	1812
Bernhard, Duke of Saxe Weimar	1639	Ditto	1812
Rubens, artist	1640	Mannheim	1809
Vandyk, artist	1641	Rauch	1812
Hugo Grotius, philosophy	1645	Tieck	1814
Maximilian von Trautmannsdorf	1650	Schaller	1804
Maximilian, Elector of Bavaria	1651	Imhof	1812
Amalia Landgrafin von Hesse	1652	Tieck	1817
Von Tromp, Admiral	1653	Kessels	1825
Lodron, Archbishop of Salzburg	1653	C. Eberhard	1814
Snyders, painter	1657	Rauch	1814
Charles IX. of Sweden	1660	Tieck	1816
Von Schonborn	1673	Ditto	1818
Ernest, Duke of Saxe-Gotha	1675	Ditto	1815
De Ruiter, Admiral	1676	Ditto	1817
Otto von Querické, inventor of air pump	1684	Rathgeber	1811
William, Elector of Brandenburg	1688	Wichmann	1818
Zinzendorf	1702	Tieck	1808
William III. of Great Britain	1702		
Ludwig, Margrave of Baden-Baden	1707	Widnmann	1841

Leibnitz, philosophy	1716	Schadow	1808
Boerhaave, medicine	1732	Leeb	1823
Moritz von Saxe, warrior	1750	Tieck	1813
Handel, musician	1753	Schadow	1810
Count von Munich, Russian Field-marshall	1767	Lossow	1841
Winckelmann, antiquary	1768	Schadow	1814
Count von Schaumburg-Lippe	1777	Ditto	1809
Von Haller, poet, &c.	1777	Ditto	1808
Mengs, artist	1779	Rauch	1808
Maria Theresa, of Austria	1780	Eberhard	1811
Gluck, musician	1787	Danneker	1812
Von Loudon, Field-marshall	1790	Kissling	1813
Mozart, musician	1791	Schwanthaler	1840
Ferdinand, Duke of Brunswick	1792	Schadow	1808
Justus Möser	1794	Schmid	1821
Burger, poet	1794	Tieck	1811
Catherine II. of Russia	1796	Werdo	1831
Klopstock, poet	1803	Schadow	1808
Heinse	1803	Haller	1826
Herder, poetry and philosophy	1803	Tieck	1815
Kant, philosophy	1804	Schadow	1808
Schiller, poetry and history	1805	Danneker	1794
Haydn, music	1809	Robotz	1810
Joh. von Muller, history	1809	Schadow	1808
Wieland, poetry and belles lettres	1813	Ditto	1807
Scharenhorst, Field-marshall	1813	Rauch	1830
Barclay de Tolli, ditto	1818	Widnmann	1841
Blucher, ditto	1819	Rauch	1817
Prince Schwartzenburg	1820	Schaller	1821
Herschel, astronomy	1822	C. Eberhard	1816
Diebitsch-Sabalkansky, Field-marshall	1831	Rauch	1830
Stein, Prussian Minister	1831	Leeb	1825
Count von Gneisenau, Field-marshall	1831	Tieck	1842
Goethe, poetry and universal literature	1832	Ditto	1808

A CHAT ABOUT WESTMINSTER ABBEY.

OUR metropolitan minster (*west* of St. Paul's), is perhaps without exception, the most beautiful, interesting, and instructive sight in London; and yet how many inhabitants of this great city are there who, but for the accidental visit of a country cousin, which led them to seek the Lions, had never seen it? and how many more to whom it is still unknown ground? They have travelled, perhaps, to York, to see the Minster there; they have sought objects of interest at Cologne; they have thrown their eyes round the Cathedral of Strasburgh—but Westminster Abbey, close at home, has escaped their investigating gaze. Let them lose no time in seeking it out. We feel persuaded that few can visit this wonderful museum of skill, genius, noble thoughts, and memories of good deeds, without an elevation of mind, an improvement in taste, and a chastening in feeling which must tend in a greater or less degree to good. Walk through it, examine it, study it, as often and carefully as you may, you will ever find some fresh claim on your attention, some beauty before overlooked, or some evidence of unpretending piety, which makes you prouder of humanity and more determined to do nothing derogatory in your own person. It is, indeed, a spot "where folly's dancing foam melts if it cross the threshold;" where thoughts that are unholy die; where the past great ones of six centuries speak powerfully to you—it is to be hoped, not uselessly.

The multitude of monuments which it contains, from that of King Henry III, upwards, (omitting, for the present, any remarks on the destructive effect produced by those erected in modern times,) render it an index to English history, and a commentary, while the specimens of the workmanship of different epochs in wood and stone, and glass and metal, which these and other portions of the building present, make it a lecturer on British art and a record of its progress. Edward the Confessor's chapel, at the east end of the choir, is alone a sufficient reward for a pilgrimage of a hundred miles. Here, where old Time seems to have secluded himself from the garish present, and reigns over remnants of the past, are ranged memorials of our early sovereigns—the pious Edward, Queen Eleanor, Edward I, Henry III, Queen Philippa, Richard II and his Queen, and the gallant Henry V. It has nothing in common with the present time, it stands alone, and cannot be realized in the mind of any one of the thronging thousands, who are passing at so short a distance from the spot, if they have not visited it. Examine the pavement, examine the shrines—the chantry of Henry V, the screen, next the choir covered with minutest sculpturing—and see how the powers of art *have* been lavished in honour of God. Our forefathers were not satisfied with the decoration of the mere face of the part in human sight—the highest exercise of their powers was deemed hardly worthy of the temple, and so long as any portion, however remote, or hidden, remained capable of improvement, so long was it deemed incomplete and requiring alteration.

Of the elegance of the Abbey as a structure it is almost needless to speak: it may be termed the finest example of the pointed style of architecture ever executed in England, and remains the most complete, with the exception of the cathedral at Salisbury. The combinations which its various parts form, especially at the eastern end, are as numerous as they are striking, and serve to impress a strong conviction on the mind, of the skill of the old builders, and the power they possessed of so arranging their structures as to excite pleasurable and lofty emotions. Amongst the most striking of these combinations is that presented when standing beneath the porch of Henry VII's chapel, the gloom in which, most artistically devised, serves to render the full flood of light, to be found in the chapel itself, striking and effective in the highest degree. Burke remarks, in his essay on the sublime, "I think that all edifices, calculated to produce an idea of the sublime, ought rather to be dark and gloomy; and this for two reasons; the first is, that darkness itself, on other occasions, is known by experience, to have a greater effect on the passions than light. The second is, that to make an object very striking, we should make it as different as possible from the objects with which we have been immediately conversant; when, therefore, you enter a building, you cannot pass into a greater light than you had in the open air: to go into one some few degrees less luminous, can make only a trifling change; but to make the transition thoroughly striking, you ought to pass from the greatest light to as much darkness as is consistent with the uses of architecture." This the architects of the middle ages well understood; they appreciated the "dim religious light," and accordingly built their ecclesiatical edifices, for the most part, with comparatively few openings. When, however, as in the case before us, the style adopted rendered larger windows necessary, they reversed the arrangement, and so still obtained the required effect. In a Gothic edifice, nothing was done without intention—everything is meaning-full, design is everywhere apparent.

Many of the striking combinations, to which we have referred, are now sadly interfered with by the modern monuments, with which the Abbey is lumbered up—monuments for the most part so absurd that they would make us laugh if they did not make us sad. Mouldings, pillars, and adornments of all descriptions have been ruthlessly cut away for them, openings have been interfered with, and even several of the spaces between the large clustered columns in the side ailes and chapels, are blocked up to the top with tasteless and incongruous masses of stone and marble, alike unsuitable and discordant in colour and design.

The sculpture of the best periods of the middle ages has an entirely distinct and original character, prompted by the spirit of the time and carried out by genius. It is in no way imitated from the master-pieces of Pagan art, which might have been used as models; but is nevertheless full of feeling, and appeals to the sympathies rather than to the eye. In the ancient tombs at Westminster as elsewhere, the sculpture is seen to be a portion of the building, conceived in the same spirit and displaying the same feeling of reverence. All the figures are in repose, all are devotional—there is no flutter, no action even, certainly no worldly action; they do not seek to record, in vain self-glory, any moment of the past, but carry us forward to the great hereafter, and inculcate humility. Alas! how sadly this contrasts with those of more recent date, where every man "for his own hand," has worked in his own way, careless of the general effect, and has not worked well. Mountains of most *material* clouds, urns, flames, figures in ill conceived and violent momentary action, accurate models of periwigs and whiskers, the evanescent fashions of a period of universal bad taste, form the staple—but why endeavour to prove what nearly all seem to acknowledge? A few weeks ago, when the writer said at the Institute of Architects, in reference to the tasteless tombs and monuments with which our cathedrals and churches have been gradually encumbered and overladen, "Like some frightful fungus, they have spread insidiously over all parts of these structures, destroying alike their beauty, propriety, and stability. Our metropolitan Abbey presents a lamentable example of the evil; and it is to be hoped that the acknowledged good taste of those who now govern there, will not merely prevent the increase of this abomination, but lead, as opportunities may from time to time offer themselves, to the removal of the excrescences now deforming that fine building, and to a restoration of its harmonious proportions and original integrity;"—the meeting at once recognized the existence of the evil and reiterated the desire for an alteration. Again we venture to re-urge it. The triforium might be made to contain many of the monuments, as has been done at the Temple Church. Perhaps, too, the Chapter House, which is about to be cleared of its present contents, (dirty shelves and presses,) could receive some without injury to itself, so as gradually to restore to our venerable Abbey its original appearance.

The present state of the ancient monuments is deplorable, and requires immediate attention. Mr. E. Blore, the architect of the Dean and Chapter, when before the Committee of the House of Commons on national monuments, in 1841, said, that he considered these monuments very sacred things, not to be touched without great care and consideration, as more harm than good might be done in attempting to improve their appearance. This is quite true, but there is nevertheless a limit to that forbearance, and this limit has been reached; for unquestionably, unless some steps be taken at once in several cases, nothing will remain to guide the restorer hereafter, and an irretrievable loss will be sustained. We should be right glad to see a general and perfect restoration commenced, a restoration which should include the removal of the ugly western towers put up by Wren, (who knew little of Gothic architecture, and liked it less,) and the completion of the central tower or spire. Some partial repairs and alterations are indeed contemplated, and the plans have been prepared: let us most strenuously urge on the new Dean, Dr. Turton, if it may be done without apparent impertinence, the importance of energy in such a matter as this, and the necessity for the greatest vigilance, in order to prevent not only the occurrence of fresh injuries, but the perpetuation of those already committed.

Amongst the earliest improvements to be made in the Abbey, is the introduction of stained glass in the rose-window and twelve lower openings of the south transept. The execution of this work, after two competitions, was entrusted to Messrs. Ward and Nixon, and is making rapid progress. The subjects for the twelve lower windows are taken from the Old Testament, and may be described as, Noah's sacrifice, Abraham and the angels, Jacob's dream, Joseph interpreting Pharoah's dream, the finding of Moses, Moses before the burning bush, Moses striking the rock, Moses with the tables of the law, David anointed by Samuel, dedication of the temple by Solomon, Elijah's sacrifice, and Josiah renewing the covenant; the figures are the size of life. The large rose-window, besides a variety of symbols, scrolls, sentences, and arms, intended to form a rich piece of mosaic work, conformable to the practice of the old glass painters, will contain thirty-two subjects illustrative of the life of Christ, wherein the height of the figures will be about three feet. The impulse which has lately been given to glass-painting in England is a pleasant sign, and cannot be too strongly aided. So firm was the belief that English artists in this department were inferior to foreigners, that the Chapter, it is said, had nearly determined on sending to Germany for the work in question; luckily, however, one or two members of it were staunch friends to English art, and succeeded in making the present arrangement; the result of which, it is to be hoped, will fully justify them for so doing.

We have not yet looked into the chapel of Henry VII, *orbis miraculum*, as Leland calls it—one of the most beautiful specimens of the last period of Gothic architecture which England or any other country can boast.[1] From its roof, "pendent by subtle magic," to the floor, the whole presents a rich lace-work of decoration. The lover of architecture, after studying the perfect development of the pointed style in the Minster itself,[2] with its acutely pointed arches, its lofty attenuated columns, its infinite divisions, finds here the style which succeeded it when the arch was becoming more horizontal, and when a love of decoration threatened, as indeed did soon afterwards happen, to overwhelm good taste, and lead to the abandonment for a time, of pointed architecture altogether.

With respect to sculpture, Henry VII's chapel presents one of the finest illustrations of early art, in England, in the series of figures which fill the countless recesses in the walls. It is said they were once three thousand in number, but this is perhaps doubtful. They display admirable feeling for art, and will well repay attentive examination. The carving too, in the stalls here, is good, and leads us to express regret that so little encouragement is now given to this branch of art in England. There are a considerable number of artists employed in it at this time, but unfortunately—such is the dominion of fashion, (another word for caprice,)—it is chiefly, if not wholly, in the imitation of old work, to be afterwards stained and sold as such. The upholsterer is the *arbiter elegantiarum*, and the result is, exactly what might be expected under such circumstances. The remedy for this, and many like evils, is, to make artistical knowledge more general, and to induce the multitudes to talk and think on the subject. With an increased public—an extended circle of admirers and employers—the powers of the artist will be more fully called into play, and the more critical that public is, the more strenuous will the efforts of the artist be to maintain himself superior to his judges.

George Godwin.

MESSRS. W. FAIRBAIRN & CO.'S IMPROVED PATENT RIVETING MACHINE.

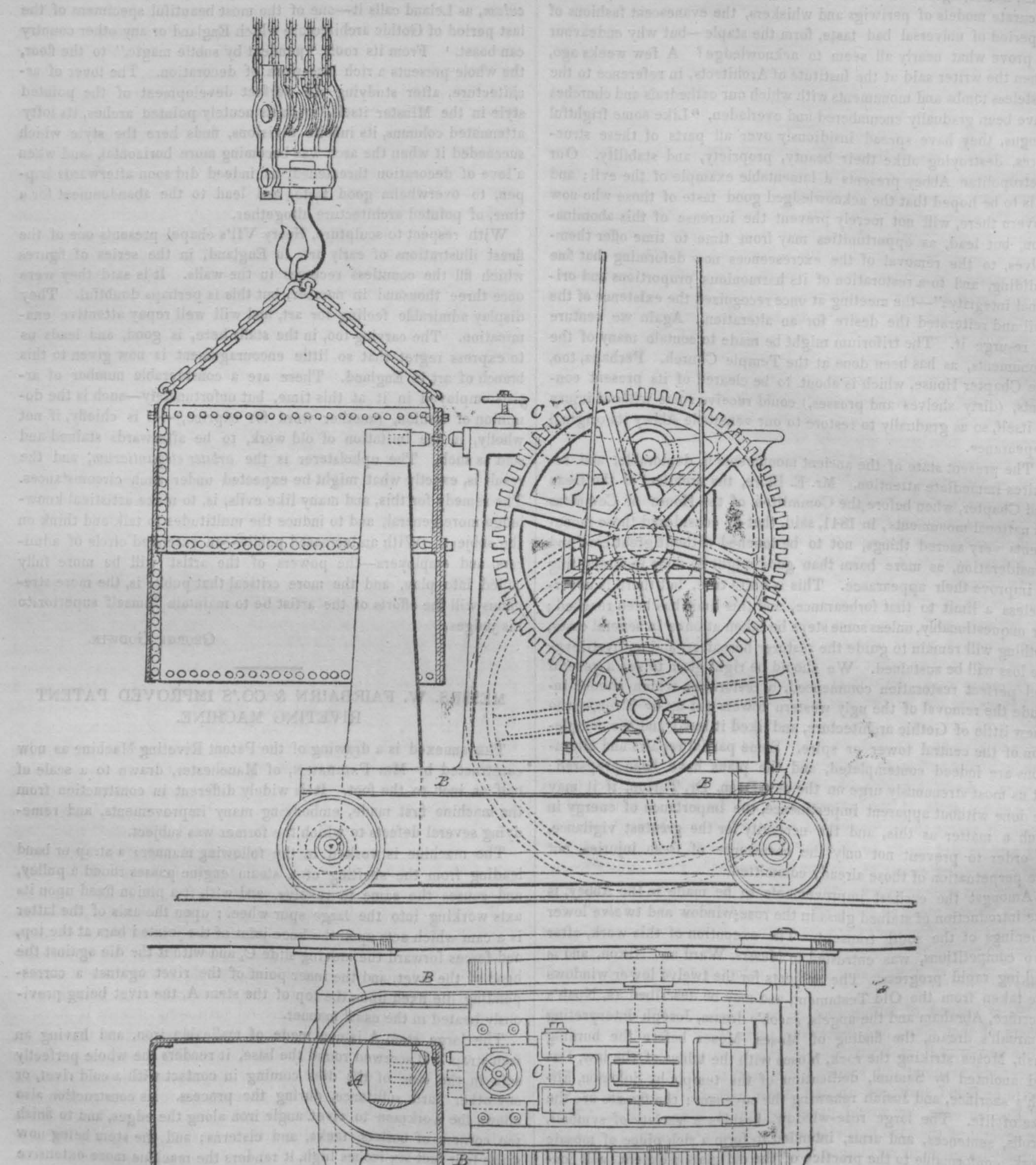
The annexed is a drawing of the Patent Riveting Machine as now constructed by Mr. Fairbairn, of Manchester, drawn to a scale of half an inch to the foot. It is widely different in construction from the machine first made, embodying many improvements, and remedying several defects to which the former was subject.

The machine is worked in the following manner; a strap or band leading from the shafting of a steam engine passes round a pulley, and causes the same to revolve, and with it a pinion fixed upon its axis working into the large spur wheel; upon the axis of the latter is a cam which acts upon the knee joint of the jointed bars at the top, and forces forward the moving slide C, and with it the die against the head of the rivet, and the inner point of the rivet against a corresponding die fixed upon the top of the stem A, the rivet being previously heated in the usual manner.

The large stem A is now made of malleable iron, and having an iron strap B B screwed round the base, it renders the whole perfectly safe in the case of the dies coming in contact with a cold rivet, or any other hard substance, during the process. Its construction also allows the workmen to rivet angle iron along the edges, and to finish the corners of boilers, tanks, and cisterns; and the stem being now made four feet six inches high, it renders the machine more extensive in its application, and allows of its riveting the fire-box of a locomotive boiler, or any other work, within the given depth. In addition to these advantages, it has a broad moving slide C, in which are three dies corresponding with others on the top of the wrought-iron stem. By using the centre die, every description of flat and circular work can be riveted, and by selecting those on the sides it will rivet the corners, and thus complete vessels of almost every shape. Another advantage of this machine is its portable form, and the facility with

[1] Commenced 1503.
[2] Commenced A.D. 1220.

FAIRBAIRN'S RIVETING MACHINE.—Elevation and Plan.



which it can be moved on rails, to suit the article suspended from the shears. The introduction of the knee joint is also a very important improvement, as it gives to the dies a variable motion, and causes the greatest force to be exerted at the proper time, viz., at the closing of the joint and the finishing of the head of the rivet.

In other respects the Machine operates as before, effecting by an almost instantaneous pressure what is performed in the ordinary mode by a long series of impacts. The machine fixes in the firmest manner, and completes eight rivets of ¾-inch diameter in a minute, with the attendance of two men and two boys to the plates and rivets; whereas, the average work that can be done by two riveters, with one "holder on," and a boy, is forty ¾-inch rivets per hour; the quantity done in the two cases being in the proportion of 40 to 480, or as 1 to 12, exclusive of the saving of one man's labour.

CANDIDUS'S NOTE-BOOK.

FASCICULUS XLVII.

" I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. "The works of Messrs. Whewell and Willis, honorary members of the Royal Institute of British Architects, reflect the greatest credit upon their penetration and learning:"—so says Professor Donaldson, and therefore so far differs *toto cœlo* from the author of a certain "Encyclopædia," who, although he does not name those gentlemen, gives a pretty broad hint as to the esteem he entertains for them and their works; which last, he has considered unworthy of being named in the list he gives of architectural publications—a list, by the bye, that seems to have been made up from a bookseller's catalogue. However, the "Encyclopædia" has got plenty of puff from some of the country newspapers, therefore, it is to be hoped that Mr. Gwilt will now become quite reconciled to "small-fry critics," of that class, who, if they do not understand anything of the subject, are most conveniently blind to defects and blunders, yet at the same time so lynx-eyed, that they discover wonderful learning and industry, where others detect great carelessness, and the mere handicraft of scissors and paste. As to Mr. Donaldson, his "learned and scientific professional brother," as he styles him, is not likely to be at all pleased at his complimenting the two W's.

II. Donaldson is certainly the most good-natured of critics—liberal of praise even to a fault, for he bestows it so freely as to render it quite common, and hardly worth having; in which respect, however, he does not exactly stand alone, yet one looks for something superior to ordinary puff, from a professional man and a Professor. After that honey, a gentle squeeze of acid from Welby Pugin will prove refreshing; and no doubt he will give us some of it by and bye, in his forthcoming work. His bill of fare promises some relish of the kind; and there are one or two capital tid-bits for him to serve up to us, should he not have overlooked them. It is a pity that he does not mean to give us a chapter on "Lost Opportunities," but a chapter would hardly suffice to enumerate them all—they would require a volume. As to his idea of recommending Gothic architecture, as our general style at the present day, and for public buildings of all kinds, it seems to be somewhat a visionary and Quixotic one. At any rate he will hardly be able to enforce his argument by satisfactory and encouraging examples, proving how successfully we can now accommodate that style to every purpose and every occasion. But what does Pugin himself mean by clapping that odd bristling *chevaux-de-frise* on the ridge of St. George's Catholic church? It looks neither useful nor ornamental—quite the contrary: nor does there seem to be precedent for it, much as it stands in need of authority to reconcile us at all to it.

III. If instead of falling foul on reviewers, anonymous critics, and others of that class, and bestowing upon them a good deal of his "Big bow-wow," as Scott calls it, the illustrious Joseph had condescended to point out some of the best architectural papers that are to be found scattered up and down periodicals, foreign as well as English ones, he would have performed a good office. There are several of the kind in the *Quarterly Review*, although of late that journal has given us nothing on the subject of architecture; and from that entitled the "Modern Palladian Architecture of Italy," he himself might have picked up some information which he does not appear to possess. No doubt there has been a good deal of flimsy nonsense written in periodicals, not only upon architecture, but other subjects also: yet it does not therefore follow that there is nothing at all good, or deserving attention, to be met with in the shape of magazine and review articles; and as the good ones, it seems, bear so small a proportion to the rest, a list of them would not have occupied a great deal of room—though as for the matter of room, Gwilt had more than he knew how to fill up, except by cramming into his book such heterogeneous stuff as tables of compound interest. Taken in general, reviewers—more especially architectural reviewers, may be the ignoramusses Gwilt represents them. Nevertheless, every rule has its exceptions: at any rate, certain it is that some who have written in periodicals are not only professional men, but those who as such stand rather high in public opinion. Professor Pugin, for instance, has written in the *Dublin Review;* and each of the other Professors—Cockerell, Hosking and Donaldson, stands suspected of having occasionally contributed to periodical publications. How they relish Gwilt's remarks may, therefore, easily be conceived. Whether the venerable Vitruvius and the great Palladio were ever guilty of any thing so unprofessional and so horrible, may be questioned, because in their times—oh! happy times for architecture!—there were no periodicals; and if there had been, those great luminaries of art, would not have put their light under a bushel. Surely an "ignorant reviewer" may be excused from admiring Schinkel, when for so doing he had the authority of all Germany. To vent his wroth on such a poor devil, looks like cowardice on the part of Mr. Gwilt, more especially as he might attack architectural heresy in "high places," and display his prowess against giants instead of dwarfs. Besides,

Thyself, friend Joseph, may at times be wrong;
Bethink thee, then, what says the song,
"Remember, where the judgment's weak,
The prejudice is strong."
And there, 'twould seem thy strength most lies.
Reviewers, why should you so rail at and despise?
On them why all thy vengeance wreak—
Reviewers, meekest of the meek,
If not the wisest of the wise?

IV. There is no department of biography in which less has been done than that of architects; and, strange to say, least of all has been done—at any rate in this country—of late years, when even the most eminent—if not exactly the ablest—in the profession have obtained only a mere passing notice in an obituary—hardly so full a one as is bestowed upon some of those "distinguished," persons of whom the world never heard while living, nor will care to remember when dead. Wyatt, Gandon, Soane, Wyatville, Wilkins, and Rickman, have passed away without obtaining more than that kind of notice. In Soane's case, indeed, it was entirely his own fault, for a handsome legacy would have secured him a splendid biographical monument from one who was always telling the world of his esteem for Sir John, but who has since written him plain "Soane," without the knightly prefix, and without *endearing* compliment of any kind. Well, perhaps poor Soane had no relish for "extreme unction," administered by an Egyptian—that is, by a crocodile.

V. "It is found easier," says a writer in the *Edinburgh Review*, "to deal with generalities and abstraction, than to descend to particulars; to frame a theory, or a philosophical essay having the slenderest application to the case in hand, than to direct the criticism to the real appreciation of the work to be reviewed." This is more especially true as regards architectural criticism, or what is given to the world as such: of general remark that has been worn threadbare, there is usually an overdose, while the building which calls it forth, obtains no further notice than two or three lines, and sometimes not even so much. When such is the case, we may without any very great breach of charity, suppose that the writers know not how to apply their own principles—supposing them to be really their own, which is doubtful, and to test by them what they profess to examine and pass sentence upon. Indeed, it occasionally happens that the opinion they express, is altogether at variance with the principles they pretend to lay down:—after twaddling about Grecian architecture, for instance, they will praise what is no better than an abominable caricature or preposterous application of it—at the best a servile copy in regard to mere columns, and those generally introduced so injudiciously as to render all the rest more insignificant in character than it otherwise might have appeared.

VI. Innovation is the bugbear of architects, and is most solemnly of all, deprecated by those who themselves do not possess a fresh idea to start from. Yet what does the history of architecture—or, indeed, of all art, present, but a series and continued course of innovation? How should we have got Gothic at all, without innovation; or having been introduced, how could it have advanced beyond its first stages? Architecture does not indeed admit of fashions, if by fashions are meant fresh patterns every month for dandies of both sexes. But change, growth, and further development, there may and must be; for the very principle of art prevents architecture from continuing stationary. If it cannot advance, it must retrograde, and become entirely mechanical, without aught worthy the name of design. It is owing to our not striving to get forward at all, but confining ourselves to repetitions of the same forms and ideas over and over again, that we at length suddenly abandon them altogether, satiated with the unvarying sameness of a style we have stereotyped, and desparing of obtaining variety, except by going to one entirely different. Thus Elizabethan is taken up by way of change from Grecian, because no one knows how to produce any novelty in Grecian itself.

VII. An architectural book, I am informed, has just appeared, edited by Lady Mary Fox: but "*edited*" has of late become such an equivocal term, that its meaning in this instance is exceedingly doubtful. No one ever heard before that Lady Mary had made architecture her study; and even were she ever so well qualified for the task, it is strange that, merely for the sake of seeing her name so introduced upon a title-page, a lady should condescend to accept the job of superintending the printing of a book. Lady Mary, however, it seems, is not above even crying "stinking fish!" for it is said in the preface that the work, which it seems is partly from the German, is incorrectly translated! If such be the case, it was then surely the duty of her editorial ladyship to revise and correct those portions instead of knowingly sending forth to the public what she was aware was very inadequately executed. At any rate there was no occasion to tell the world how utterly unable she was to get through the *job* she had undertaken, and to confess her own incompetence with a degree of ingenuousness that amounts to stupidity.

OBSERVATIONS ON RIPON CATHEDRAL.

Read at the Royal Institute of British Architects. By Mr. Morris.

> "Edrede with powere untille the north went
> Alle the toun of Ripon he wasted and brent."
>
> Peter Langtoft.

In the seventh century an animated controversy divided the polemics of the Anglo-Saxon church concerning the time of celebrating Easter. The Northumbrians observing the Irish tradition, kept the festival upon the Sunday that fell between the 14th and 20th days of the Paschal moon, while in most parts of the country the Roman practice was followed. Thus Bede tells us that two Easters were sometimes observed in one year, and the Northumbrian king and his queen being divided in opinion, it would happen that when the king having completed his Lenten fast was celebrating Easter, the queen still fasting was spending Palm Sunday.

Wilfred, an ecclesiastic, had at the age of 20 been sent to Rome under the auspices of queen Elfleda, for the purpose of acquiring at the papal see, the best information on the subject of dispute, and on his return is said to have taken a distinguished part at the Synod of Whitby, held in 664; and his success was followed by his appointment to the Episcopal Chair of York, from which he was afterwards twice ejected, on the last occasion being absent for 10 years, and it would seem that he visited Rome in both intervals, and found a sure if not a powerful ally in the pope.

In the year 661 Alchfrid, king of Deira, bestowed upon Eata Abbot of Melrose and Lindisfarne certain lands at Ripon, where, allured by the beauty of its situation he built a monastery. But soon after its erection the monks, (among whom was St. Cuthbert,) on account of their nonconformance to the Catholic observance of Easter, were expelled the monastery by Alchfrid, who then conferred it, endowed with 30 hides of land, upon Wilfred, who, notwithstanding his subsequent elevation, retained it during his life. King Athelstan gave it the privilege of sanctuary, which extended a mile round the church, so that not only the church but the whole town was a place of refuge to all who fled to it. One (if not more) of the crosses marking the bounds of sanctuary yet remains.

It would have been strange, indeed, had a prelate, endowed with Wilfred's mental and physical energy, made repeated and protracted sojourns in the "Eternal city," without acquiring some regard for its architectural treasures and a desire to emulate them on his native soil. That he was thus affected, we have the most satisfactory evidence; and ecclesiastical architecture in this country was more indebted to him than to any other person of that age. Notices of his works are found in his biographer Heddins, Richard of Hexham, William of Malmesbury, and other ancient writers, of which a summary sufficient for our present purpose will be found in Britton's York Cathedral and the Chronological Volume. From these we learn that he erected in Ripon a church of hewn stone supported with various columns and porticos, and completed it from its foundation to the summit.

"The church of St. Andrew at Hexham he built, laying the foundations deep in the earth with great care, forming crypts and subterranean oratories, and winding passages. The walls, extending to a great length, and raised to a great height, were divided into three distinct stories, supported by polished columns, some square, and others of various forms. The walls and likewise the capitals of the columns by which they were supported, and the arch of the sanctuary, were decorated with histories and images and different figures, carved in relief on stone, and painted with colours, displaying a pleasing variety and wonderful beauty. The body of the church was likewise surrounded on all sides by *pentices* and porticos, which, with the most wonderful artifice, were divided above and below by walls and winding stairs. Within these winding passages and over them were stairs and galleries of stone, and various methods for ascending and descending, so ingeniously contrived, that a vast multitude of persons might be there and pass round the church without being visible to any one in the nave below. Many oratories also, most retired and beautiful, were, with the utmost care and diligence, erected in the porticos both above and below, and in them were placed *altars* in honour of *the blessed mother of God*, the Virgin Mary, St. Michael the Archangel, St. John the Baptist, and the Holy Apostles, martyrs, confessors, and virgins, with all becoming and proper furniture belonging to them."

I have transcribed this passage relative to the church at Hexham, as its circumstantial character can hardly fail to be interesting; and it illustrates in a very decided manner the highly artificial models copied by the architect. Indeed, I question whether old St. Paul's, Salisbury, Westminster or Durham, in the very zenith of their magnificence, could have furnished more glowing images to the pictoral imagination of the good old chronicler, Richard the Prior, who wrote towards the end of the 12th century, when the church after 500 years, though bowed and stricken with age, retained like a patriarch, the indelible traces of former glory.

Wilfred is said to have erected two other churches at Hexham, besides several in other parts of England; and Bentham supposes that he superintended the erection of the church and monastery of Ely. Indeed, he appears to have been equally celebrated for his theological and architectural acquirements, being eminent for his knowledge and skill in the science of architecture, and was himself the principal director of all those works in concert with the excellent masters whom the hopes of preferment had invited from Rome and other places, to execute the plans which he had formed.

William of Malmesbury also notices the beauty of the pavements; and there is little doubt that where so much emulation existed, an attempt to imitate the mosaics of Rome would be made. In the small, half ruinated, hospital chapel of St. Mary Magdalen at Ripon, is a venerable relic of some such effort, with tesseræ about half an inch square; and on the site of the high altar at Fountains' Abbey, a pavement remains which has glazed tiles of various forms and colours to suit the geometrical figures of the design, which exhibits great elegance and variety; and I think this kind of paving may be considered to have intervened between the former and the inlaid or encaustic tiles met with at Romsey, Salisbury, Winchester, and many other places, an attempt to revive which method has lately been made with some success, and from the present state of the manufactures in pottery, the most beautiful productions may be expected. At Winchester are to be seen some examples of embossed tiles, or with the ornaments raised from the surface or ground.

In Bishop Wilfred's time then we find the church and monastery settled on a permanent footing—his labours and benefactions endeared him to the inhabitants, and the demonstration of rapturous and enthusiastic affection which marked his return from exile, is still commemorated by the annual observance of a mimic pageant. The church, however, that he raised with so much care, and so cunningly adorned, and the monastery whose walls so often reverberated the applause of his virtues, are now no more seen, and the finger of tradition alone, points out the spot where once they stood.

The present cathedral occupies a more elevated and commanding site to the westward. It was commenced by Archbishop Thurston, soon after his advancement to the see of York, (in 1119). The plan was a simple cross, and the style Anglo-Norman with semi-circular and pointed arches promiscuously applied. The walls, as usual in similar buildings, are thick enough to allow galleries or passages to be formed in them. The doors are ornamented with shafts and arch mouldings, in which richness is produced by the repetition of a simple elementary form; and it is worthy of notice, that in the Norman arches the blocks of stone, though moulded or carved in a variety of ways, never wholly lost the original square figure, previously given to them. Without asserting, therefore, that at this period the mouldings and ornaments were actually wrought after the stonework *was set*, such a disposition of the mouldings would tend very much to simplify that process: and it will further be found that these ornaments are not unfrequently modified to suit the actual size of the blocks. There is a low central tower with good detail; and immediately under this is a small crypt or cell, with access from the nave, and also from the choir. To what use it was appropriated does not seem very clearly decided, its extreme dreariness suggesting the idea of a penitentiary; and the small recesses in the sides suitable for the reception of a lamp or crucifix assisting the notion. It may have served simply as a confessional; but whether intended for the momentary reception, or more *perdurable* home of the sinner, or the fugitive from the arms of the temporal power, it is evident that the priest entering from the choir could communicate with and not be seen by a person brought down from the nave. For this purpose there was an orifice in the wall that has acquired the name of St. Wilfred's needle, which the more energetic visitors make a point of endeavouring to get through: and the fine polish acquired by the stone in its contact with silk and broadcloth, show that the attempt is pretty generally made with success. Since the completion of the original structure, no building has perhaps undergone such important alterations without a more complete destruction of its individuality.

The transepts, however, bear more legibly than any other portions, the impress of the 12th century, but the inner roofs appear never to have been completed. Small shafts suited to support the foot of a groin (revealing a purpose unfulfilled) are carried up (here as in many other instances) story after story, and are at last left without adaptation either to a flat or vaulted ceiling; and thus from the absence of an homogeneous and appropriate inner roof half the effect is lost. How lame and abrupt does the flat ceiling at Peterborough appear to an eye that has dwelt on the masculine vaulting of Durham! The cause of the very few instances of Norman groining remaining, except in crypts, and the fair presumption that not many ever existed, is a subject open to investigation, and a speculative idea may be not without its utility in eliciting satisfactory information. Thick as the walls of that period are known to be, the risk that would have attended charging them with stone ceilings, without the auxiliary resistance of external buttresses, may have become an object of anxiety with the builders, and the execution of such works in stone may have been attended with difficulties which even at this time would be considerable, and may then have proved altogether insurmountable, except under the most favourable circumstances, and amplitude of means. The centering alone, if considered for a moment, is an object involving so considerable an amount of expense and practical skill, that we cannot wonder that even in the best days of the art, methods should have been devised for dispensing with it, and hence doubtlessly arose the adoption of wood at Lincoln, York, and elsewhere. Did not the Norman builders feel and shrink from the difficulty like their successors, but without the good fortune to hit upon so happy an expedient? We know that they affected the groin, from its constant adoption in crypts and ailes, when a moderate span facilitated its execution. As the central tower presented the strongest abutments for an arch of any part of the church, it is possible that a groin existed there similar to that at Lindisfarn, in Northumberland, and causes for its non-existence, at the present time, are by no means deficent. Before leaving the transept we may notice that on the east side of each, there is a chapel of two arches; that in the north transept being nearly coeval with the church, and that in the south, of the fourteenth or fifteenth century.

The choir comprised originally three arches only, but was subsequently increased to six. The effect is curious at first, from the circumstance of the triforium arches being filled with tracery and glazed, and the roofs having been lowered. It looks, therefore, like a double clerestory. The addition of the arches appears to have been carefully made to assimilate with the original work, but subsequent alterations bear the characteristic of their own date. In 1319, the church was burnt and greatly injured by the Scots, but restored by the munificence of Edward III, Melton, archbishop of York, and others; and the "steeples" were then added, of which the central one, 40 yards high, was called St. Wilfred's.

There is an old print which shows spires on the central and western towers similar to Litchfield. The former was blown down in 1660, destroying in its fall a part of the south side, of which the reinstatement (said to have been done at the expense of one of the prebendaries) is still perceptible, by the variation in style. After this accident the other spires were removed. In the south aile is a large piscina, probably used for washing the sacerdotal linen, and round the the sides and end there was arched-headed panelling, but part of this is now displaced by the altar screen, erected some few years ago from a design by Mr. Blore, under whom also the groined ceiling was restored, in which are preserved the ancient wooden bosses, which are very beautiful. The east window, erroneously said by Rickman to be of five only, consists of seven lights, and is a fine example of the kind. The clear opening is 48 feet high. Sir William de Plumpton was founder of a chantry at the altar of the Holy Trinity behind the high altar. The act of endowment is dated at Ripon on Wednesday, the feast of the conversion of St. Paul, 20 Edward III, 1345, and was sealed with the seals of Henry de Plumpton, the chaplain first appointed thereto, and of Sir William de Plumpton, which bore the impression of a shield, and on it five fusils, with the name written on the circumference. This chantry was screened from the rest of the church, and under lock and key, but no vestige of it remains.

Near the altar on the south side of the choir are three sedilia and a piscina of curious and elaborate design and skilful execution. The arches are cinquefoiled, the cusps being ornamented with small grotesque heads or other figures, which at the first glance appear to terminate the design; but, on closer inspection, it is found that the small bas-relief first seen is merely the crown of another head in high relief, of a figure falling into bas-relief and covering the soffit of the arch. These figures have human heads with the bodies of quadrupeds. They are of either sex and habited in full monastic costume; and the stout friar is regarding, with an expression too energetic to be perfectly platonic, the beautiful coy, and wimpled [1] nun. Seats of this kind are not of unfrequent occurrence in English cathedral and other churches, as well as in those of the continent: "at Seus, on the epistle or south side of the high altar are five seats. One for the celebrant, (which is highest,) two for deacons, and as many for subdeacons, all officiating while the other priests were in the choir." "*One single seat*," continues the essayist, (*Clark in the Archæologia,*) "is accounted for by the *choir* performing the part of *sub-deacon*, and one priest that of celebrant and deacon. In churches better endowed, beside the celebrant one performed the part of deacon and subdeacon. In such churches were *two seats*. Thus the number was proportionate to the richness of the endowment, and the seats intended for the officiating clergy only. The bishops' seats, were at the east and by the side of the altar. The choir is rich in carved oakwork. The stalls are furnished with misereres and tabernacle work, (which is said to have formed the model for the new work in the choir of York Minster.) The throne is also an object of interest, as presenting one of the earliest evidences of the architectural attainments of the noble Earl, the President of the Institute of British Architects.

The organ screen is of bold and original character, without pretending to the extreme elaboration of that at York. Adjacent to this stands part of a rich stone pulpit. The central tower has for some generations, presented a most singular and heterogeneous spectacle, but at the same time affording to the professional observer a valuable comparative view of the varied proportion and effect of the first and latest eras of true Gothic. In point of expansive lightness, the earlier style is certainly entitled to our admiration, though mass and richness may be exclusively the merit of the latter. Three of the piers of the central tower were cased in the perpendicular period, and the arches of the choir and south transept were also completed; but the fourth pier and the arches of the nave and north transept retain their original form. It is also illustrative of the method pursued to find the perpendicular work carried on the two sides quite up to the battlements. The immense size of the piers and the increased height of the springing, has the effect of contracting the opening of the arch, and also of rendering it necessary to ramp up the longitudinal crown rib of the groin.

Taking our survey in chronological order, the next point for consideration is the west front, which comprises the end wall of the

[1] The wimple is a part of the head dress.

nave and the two flanking towers, each of which is about 28 feet wide and 112 high. The present termination is not original, the battlements and pinnacles being of much later date. As to the mode in which they were originally finished it may be difficult to furnish a satisfactory suggestion; but of that which remains it would be still more difficult to convey an adequate impression. The simplicity of its outline, the unbroken massiveness of its general feature, and the rich and effective detail, respectively contribute to the grandeur of an ensemble unsurpassed by any building of its date.

The lower story has three doors into the church, and the second five successive windows extending the whole width of the nave, with a passage in the thickness of the wall. The second stage has an equal number of windows, the heads of which are elevated towards the centre to compose more readily with the gable, which is filled up by a triple window and trefoil panel. The windows are of two lights with trefoil heads and a trefoil in a circle above. Between the windows are piers of several shafts with foliated capitals, and the pierced pyramid or four-leaved rose; and the wall is very thick here to receive the many shafts and deep receding mouldings with which they are charged. The buttresses of the towers are broad and flat, with shafts in square recesses at the quoins, and run the entire height without diminution; the windows (except that some are filled with louvres) corresponding nearly in form and date with those of the central front. It is an interesting circumstance that the progress of almost every change in this edifice can be traced at this moment with no other guide than a little reflection, and with nearly as much clearness as the most circumstantial chronicle could have recounted them. The Norman nave, for instance, is shown to have extended as far westward as the present, from the fact that the builders in making their addition, left as much of the old work remaining as could be rendered available; and a portion of the old nave has thus been preserved, and the perfect coincidence of the joints of the piers with those of the west wall, show that the formation of the fine arches into the towers from the nave was predetermined in the design of the architect, and not an afterthought as might on a cursory view be imagined; indeed, it may be noticed that the interiors of these towers were finished with great care, and were intended to be entirely open to view from the floor to the roof, where the walls are terminated by a cornice and corbel-table. The moulded piers and arches of the lower stories are very fine, and become plainer in proportion to their remoteness from the eye. At each story was a gallery of communication, not only round the interior of each tower, but across the front from one tower to another.

I should have noticed that while the pyramidal flower is abundantly used in the vertical lines and in the arches, the flattened uncut pyramid, usually called the nail head, is adopted with equal constancy in the horizontal bands and dripstones; yet there is not the slightest taint of monotony discernible throughout. Beautiful as the principle of construction here observed must be generally deemed, giving an appearance of the utmost solidity and strength, with a comparatively small amont of material, it is to be regretted that there was a practical disregard of *bond*, and from the very inconsiderable proportion of horizontal masonry the towers were divided by the windows into four insulated vertical piers, with no adequate tie to meet the contingency of a tendency to spread at the top. The subtle workings of half a dozen centuries, however, manifest the necessity for a precaution that was not contemplated by the builder.

It is, I think, pretty evident that the primary plan was a simple Latin cross, without ailes. The transepts retain their original form, except that chapels have been erected in the east walls, and arches have been opened into the ailes of the nave; while the continuation of the base mouldings, and other external decorations of the towers, attest the absence of ailes at the time of their construction. The present nave may be referred to the close of the 14th century, and is a fine masculine example of that date. It has no triforium, but the clerestory windows are large, and have a gallery running through the piers. The wall ribs which exist indicate the purpose and form of groined inner roofs; but it is to be regretted that this part of the design has never been effected; and the external pinnacles were also left in an unfinished state.

Although the interior of this church cannot boast much of the rich garniture of ancient monuments or mortuary reliques, its impression and venerable aspect cannot fail to call forth our admiration and respect; and the circumstance of its comprising fine decisive portions of the consecutive styles including Norman and perpendicular, render it an object deserving the careful attention of the architectural student and antiquary.

It only remains to notice a small building on the south of the choir, a lower apartment of which has obtained some celebrity in modern times as the bone-house, from the immense number and symmetrical disposition of the exuviæ of innumerable tenants of yet more circumscribed and darksome chambers, from which they were ejected some half century ago. They are now built in masses like masonry, and exhibit an affecting display, to speak in the language of heraldry of *morts* and *saltires* argent. (There was a similar instance at Sligo and another at Hythe.) This charnel house has certainly the characteristics of extreme age, and the formation of the vaulting accords with the earlier imitations of classic examples. The apsis at the east, and certain external details also, attest its ancient foundation. Immediately above is an apartment now used as the *vestry*, but formerly the chapel, to which the part just considered formed the crypt. It is entered from the aile of the choir, and is of a very simple character; vaulted, and retains its ancient piscina. This building has been deemed anterior to the body of the Minster; but when we consider the casualties to which, from its position, it would have been subject during the erection of so large a pile immediately contiguous, it will probably be more rational to assign it a contemporary date. May it not have been the lady chapel, or chancel chapel? of which there is a fine example now used as a school at the west end of Norwich Cathedral, with a crypt below; and it may be borne in mind that both Norwich and Ripon are Norman foundations without crypts.

THE EXPLOSIVE FORCE OF GUNPOWDER.

The recent successful destruction of the Round Down Cliff, at Dover, by gunpowder, of which a full description was given in the February number of our *Journal*, suggests a consideration of the explosive force of that agent, and of the best means of applying its power.

The circumstance which excited most surprise in the blast at Dover, was the absence of all indication of explosive effort. That the cliff should have been rent asunder by the force of the immense quantity of gunpowder employed, was to have been expected; but that the effect should have been produced so gradually, without any report or flame, or other usual accompaniment of an explosion of that agent, appeared contrary to the ordinary conception of blasting operations, and induced the operating engineers to imagine, at first, that the charge had missed fire. The result has shown that Mr. Cubitt adjusted with great exactness, the amount of power to the resistance to be overcome; and it has shown, practically, that the explosive force of gunpowder, in any quantity, may be controlled, and brought to act with a steady effort, like any other moving power. Had the quantity of powder been much greater than it was, or had the same quantity been placed nearer to the face of the cliff, there can be little doubt the blast would have been accompanied by all the usual phenomena of explosion. Had the quantity of powder been less, probably even to a small degree, its force would have been either pent up within the rock, without producing any effect, or it would have found vent by blowing out the tamping.

The force of ignited gunpowder, it is generally admitted, arises from the sudden generation of a quantity of a permanently elastic gaseous fluid, and the expansion of that fluid by the heat excited during the ignition of the powder. The volume of elastic gas generated by the explosion of gunpowder, after it is cooled down to the temperature of the atmosphere, has been determined by experiment to be 244 times greater than the bulk of the powder exploded. It is calculated that the heat produced by the ignition of the powder expands the generated gas into 1000 volumes at the moment of explosion; and that, consequently, fired gunpowder exerts a pressure equal to 1000 atmospheres, or about 6½ tons on the square inch.

The 18,000 lb. of gunpowder used in the blast at the Round Down Cliff would occupy about 300 cubic feet, and the capacity of the three chambers made to contain it was about 750 cubic feet. What space was left between the tamping and the powder chambers, we are not aware; but it would appear, from the published reports of the operation, that the tamping was rammed not far from the powder. We will assume, therefore, the total space within which the gunpowder was confined, to have been 900 cubic feet. This space would be three times the estimated bulk of the powder, exclusive of the containing barrels and bags, therefore its first impulsive effort on being ignited would be $1000 \div 3 = 333\frac{1}{3}$ atmospheres, or about 5000 lb. the square inch; and the force of the permanent generated elastic fluid, when cooled, would be $244 \div 3 = 81\frac{1}{3}$ atmospheres, or about 1200 lb. to the square inch. Now, if we suppose the space within which the gunpowder was confined to have been cubical, each of the six sides would have exposed an internal surface to the action of the gunpowder of 100 square feet, equal to 14,400 square inches. As the pressure, according to the preceding calculation, would in the first instant be equal to 5000 lb. the square inch, the impulsive effort on each side of the cubical chamber would be 72,000,000 lb. or 32,143 tons. As the point of least resistance must necessarily have been towards the face of the cliff, the acting power may be considered as having been exerted only in that direction; therefore the cliff would be forced outwards with an impulse upwards of 32,000 tons. As the rock yielded to this immense power, the pent-up air would expand, and its force would consequently be diminished. The cooling of the generated gas would also greatly weaken its expansive force, and its gradual escape through the fissures of the falling rock would prevent any sudden explosion.

The sound which was heard was that of the rending of the solid rock, and not the firing of the powder; for it is well known that the explosive report of any detonating body is caused by the concussion of the air. This fact is proved by the firing of explosive mixtures of hydrogen and oxygen gases in a strong glass apparatus, for the purpose of obtaining the product of the combustion of the two gases. The apparatus usually employed contains about half a pint, the explosion of which quantity of the mixed gases, when in contact with the atmosphere, is sufficient to produce a report as loud as the firing of a pistol; but when the gases are fixed in a closed vessel, no report whatever is heard. This experiment proves also, on a small scale, the possibility of controlling explosive forces. The expansion of an explosive mixture of hydrogen and oxygen gases at the moment of combustion, amounts to 15 times its original volume, which gives a pressure of 15 atmospheres, or about 225 lb. to the square inch; yet the glass bottle in which the gases are fired is sufficient to control the explosive effort, and to prevent even any sound from being heard.

The quantity of gunpowder requisite in ordinary blasting operations must depend altogether on the hardness of the rock, and the mass intended to be moved. The proper adjustment of the quantity of powder to the resistance to be overcome, forms, however, an important consideration, for an excess of powder is not only a wasteful expenditure of a valuable agent, but it renders the operation more dangerous by the dispersion of fragments in all directions, and it not unfrequently diminishes the effect of a blast by concentrating the direction of the impulsive force. This is particularly the case in warlike operations, where the object in springing a mine is to make the destructive effects extend as far as possible. The aperture produced by the explosion, when a mine is properly charged, is a cone, the diameter of the base of which is double the height, taken from the centre of the mine. This calculation is founded on the supposition that the materials to be removed are either earth or soft clayey soil. The allowance of powder recommended for such mines is about 10 lb. per cubic fathom when the materials are loose earth, and for strong clayey soil about 16 lb. It is found that when the charge of powder greatly exceeds those quantities, the materials immediately above the powder are alone blown up, that the aperture is nearly cylindrical instead of conical, and consequently the sphere of its influence is diminished.

The explosive effects of a charge of powder in blasting, depends also materially on the mode of tamping. This is a point which, until a comparatively late period, was altogether overlooked, and it is not even now so generally attended to as its importance deserves. The notion which formerly obtained was, that the impulsive effort of the powder was greatly increased by ramming it tight. In gunnery practice this is correct; for when the ball is rammed closely to the powder, it is propelled with greater force than when it is not. But the required effects in the operations of blasting are exactly the opposite of those in gunnery. The ball and wadding of the gun may be considered as the tamping of the mine. To blow out this tamping without bursting the gun, is the object in gunnery—to retain the tamping and to burst the chamber holding the gunpowder is the object in blasting. To attain these different ends, the methods adopted in the two cases ought of course to be different. The well known fact that when a ball is rammed only a short way down the barrel of a gun, it will burst before the ball is forced out, affords a very instructive lesson in the practice of blasting, and shows clearly that to produce the most effect in rending the rock, and to run the least risk of blowing out the tamping, ample space should be left between the tamping and the powder. It is true that by leaving such a space for the expansion of the generated elastic fluid, the intensity of its action is diminished, but the same amount of power is distributed over a larger surface; its action accordingly approaches more to that of an ordinary mechanical force, and the liability to split the rock into small fragments is thereby decreased.

One great advantage in mining operations, derived from the practice of leaving a space between the tamping and the powder, arises from its admitting the use of loose dry sand for tamping, instead of requiring the blast hole to be filled and rammed tight with hard substances. The labour, the trouble, and the danger of tamping by the common process, renders the substitution of dry sand a great advantage, as the risk of igniting the powder by striking a spark, is entirely removed; and we suspect that in those cases where it has been found to fail, and the tamping has blown out, that the cause of failure may be attributed to the neglect to leave a sufficient space between the tamping and the powder.

The manner in which the space between the powder and the tamping operates in preventing the latter from being blown out, has been explained in the following manner. The force of fired gunpowder may be considered as proceeding from a point, and radiating in all directions round it. This force must, therefore, participate in the nature of all central forces, and diminish in intensity as the square of the distance. When a ball is rammed close to the powder, it approaches near to the point whence the force emanates, and sustains consequently its full effect; but when the ball is placed farther from the point of radiation, the force acting on it may be diminished many times within the space of half an inch. Suppose, for example, that a musket ball which, when close to the powder, is within a quarter of an inch of the centre of radiating power, were placed a quarter of an inch from contact with the powder, the impulsive force it would receive would be diminished four times. If it were removed to a distance of one inch from the charge, the force acting on it would be diminished sixteen times. If, therefore, we view the first impulsive effort of fired gunpowder as a radiating force, we perceive at once the cause of its diminished action on the tamping of a mine, when a space is left between it and the charge, and whether the tamping materials be sand or hard fragments of rock, the vacant space must be equally advantageous. Should the resistance be too great to yield to the first explosive effort of the gunpowder, the direction of the action of the pent up elastic fluid would cease to be radiating. It would resemble the pressure of compressed fluids, and act uniformly in all directions. The tamping would then be acted on by a power equivalent to the compression of the generated gases, and in a direction tending most effectually to force it out. It is under such circumstances, we conceive, that the tamping, whether of sand or rock, is most frequently blown.

The mode of tamping with dry sand has been brought into notice more particularly within the last two years, in connexion with Mr. Martyn Roberts's plan of blasting by galvanism; but it was known and practised successfully, we believe, 30 years ago, at Lord Elgin's mines at Charlestown, in Scotland. It is to be regretted that an improvement, attended evidently with so many advantages, and which is calculated to prevent accidents in the dangerous occupation of blasting, should have made such slow progress that more than 30 years have elapsed since its introduction without its general adoption.

IMPROVEMENT OF GEODESICAL INSTRUMENTS.

As connected with the profession of a civil engineer, the principles and practice of surveying is an important branch of study; under this term, we do not confine our meaning to the delineation of a few fields, or of a long narrow slip of land, such as railway plans usually present, but to the survey of extensive tracts of country or of islands, usually denominated trigonometrical surveying, because that branch of mathematics known as plain and spherical trigonometry, forms the basis or principle upon which such surveys are carried on. This branch of surveying has hitherto been principally confined to the officers of the corps of royal engineers, by whom the trigonometrical survey of the united kingdoms has been for so many years conducted; but although too much unheeded by students in civil engineering, it forms a legitimate branch of their studies, otherwise they cannot be said to be eligible to occupy such important stations as surveyors-general of our colonial possessions, where such surveys are so much needed, nay almost indispensable. Connected with this subject, the knowledge of the use and adjustments of the higher class of geodesical instruments is necessary, such as theodolites of large dimensions, but more especially an instrument called the altitude and azimuth instrument, from its two-fold application to the measurement of vertical and horizontal or azimuthal angles, and its peculiar applicability to the purposes of so much of astronomy as is requisite in such class of surveying, or we may call it the instrumental link which connects astronomy with geodesy and geography; any improvements, therefore, in the construction of instruments thus connected with the profession we profess to advocate, come fully within the limits of our province, and therefore we are desirous of calling attention to the following extracts from a paper that has been read before the Royal Astronomical Society on January 13th last, entitled "On a new arrangement of a Vertical Collimator attached to the Altitude and Azimuth Instrument." By William Simms, Esq.

"The only essential respect in which the altitude and azimuth instrument now before the society [1] differs from similar instruments by which it has been preceded, is this. The azimuth or vertical axis is perforated and fitted with an achromatic object-glass having a diaphragm in its focus, so as to serve, in conjunction with the spirit-level upon the instrument, as a vertical collimator.

"At present the spider lines in the diaphragm of the collimator form an acute cross, subtending an angle of about 30°; but the preference of this arrangement over two parallel lines placed very nearly together, so as to present a narrow space for bisection, admits perhaps of question; my own habit being that of bisecting an angle by a line, leads me to give to it the preference, although I have found by experiment that very satisfactory results may be obtained by the other arrangement.

"In this state of things, if the telescope be directed vertically downwards, the image of the cross in the collimator will be seen upon the diaphragm of the telescope; and the adjustment, independently of verticality, which must be effected by the spirit levels attached to the instrument, consists in so rectifying the optical axes, that the centres, or intersecting points in the telescope and collimator, remain coincident during an azimuthal revolution.

"The mode of adjustment, described in order, may be as follows, admitting, however, of variation at the pleasure of the observer.

"1. It will be found convenient that the instrument be first generally levelled:—the azimuth axis by turning 180° in azimuth, and correcting by the feet screws of the tripod and the adjusting screws of the spirit levels; but, in all cases, if the error be not beyond the range of the scales, it is far better to leave these screws untouched, and to apply the correction by reference to the divisions upon the scales. The axis of the altitude circle must be rectified by the striding level, exactly in the same manner as in the transit instrument; all which, however, is too well understood to need a particular description, in this place.

"2. To adjust the line of collimation, bring the vernier marked A to 90° or 270° upon the azimuth circle, and, by means of the adjusting screws at the eye end of the telescope, make the middle vertical, or meridian line, bisect the angles of the collimator cross, turn 180° in azimute, and correct half the error by the above-mentioned screws, and the remaining half by moving the object-glass of the collimator.

"3. To correct the nadir point, set the vernier A to 0° or 180° upon the azimuth circle, 90° distant from its former position, and make the middle horizontal line bisect the angles of the collimator cross; turn 180° in azimuth, and correct half the error by giving motion to the telescope by means of the tangent screw, and half by moving the object glass of the collimator. The micrometers should now be set to the zero points upon the altitude circle. By those, however, who prefer numerical corrections to mechanical adjustments, which, when extreme accuracy is aimed at, are always tedious and difficult to execute satisfactorily, the nadir point may be readily determined by reading the altitude micrometers with the circle in the reversed position. The indications of the spirit-level fixed to the micrometer bar must, of course, be carefully attended to in such a determination.

"I shall conclude this notice by observing that the new application of the collimator does not deprive it of any uses and conveniences which it has in any other form, while at the same time it possesses advantages peculiar to itself. Its property, in common with the vertical floating collimator, of enabling the observer to set the axis of the altitude circle perfectly horizontal, irrespective of the riding level, is one which the level collimator does not possess. In common with the others, however, it affords a ready means of verifying and correcting the essential adjustments of the instrument without reference to any external object. An object adapted for such purposes should be both distant and well defined, conditions which imply a clearness of atmosphere perhaps not generally met with in any climate, and much less in that of our own country; moreover the collimator is equally available by night and by day: the light of a small lamp or taper being sufficient to render the lines visible.

"But it has greatly the superiority, particularly in operations out of doors, over the vertical floating, and also over the level collimator, because the latter requires supports independent of, and equally steady with, that upon which the instrument itself is placed; things by no means easy of attainment under any circumstances, and to the scientific traveller often perfectly impracticable.

"Neither is it a small advantage to dispense altogether with an additional instrument, which, to say the least, lessens the number of the traveller's cases, and with them his cares also. An extra instrument may by accident be injured, or through forgetfulness left behind, or for want of time to set up, or a steady support when set up, prove useless when it is most needed. But, by the new arrangement, the collimator becomes part and parcel of the instrument itself, and is so completely protected from injury that an accident could hardly impair or destroy it without at the same time destroying the entire instrument. Its introduction, too, into the perforated axis adds so little to the original cost of an instrument, that it may make a final claim on the score of economy."

[1] An instrument with the collimator attached was exhibited in the meeting room of the Society.

THE VELOCITY OF WATER IN VERTICAL PIPES.

WE have been favoured with another letter from our able correspondent T. F——N, in reference to our position that water flows down vertical pipes with only half the velocity due to the height when issuing from an orifice. Our correspondent is not convinced by our arguments, and he reiterates his former opinion supported by many illustrations, and by the grave authority of Belidor. The same fault, however, which we before complained of, pervades the whole of his present argument; he takes for granted the question in dispute, and assumes, as established data, the very points respecting which we are at variance. We will let him, however, speak for himself.

"SIR—I am sure that, if all your readers derived as much useful information and pleasing instruction, as I am bound to say I did, from your remarks in the last month's *Journal*, on the 'Velocity of water in vertical pipes,' conveyed in a style at once clear and copious, they must look forward anxiously for the fulfilment of the promise in the concluding passage, of returning at some future period to a subject deserving so much consideration and study. Before you do so, however, I am anxious to point out to you what I conceive to be an error in your reasoning, and, at the same time, uphold the assertions contained in my last letter on the subject.—1st. That the velocity of the column of water in a vertical pipe *maintained full*, is not *half* that due to the height, but that it is expressed by the same formula as for all other falling bodies.—2nd. That cohesion does not satisfactorily explain the continuous flow of water in a vertical pipe; in other words, that there would be a continuous flow in the pipe even if one particle did not cohere to that immediately above it.

"It may appear presumptuous in me to endeavour to reply to your remarks, and to maintain these positions after reading your able article on the subject; but an explanation of them so clear and so obvious has occurred to me; and even your own article contains such ample proof of the truth of my assertions on the main point at issue between us, namely, the velocity of water in a vertical pipe, that even at the risk of being charged with presumption, and under all the disadvantages of endeavouring to maintain a discussion with one superior to me in scientific acquirements, I am tempted to offer you a few more remarks.

"I think it will be well to treat first 'the velocity of the water in the pipe,' that being the chief point of difference, and also because, succeeding in proving this, I think it will appear as a necessary consequence, that the uniform flow of water in the pipe is quite independent of the cohesion existing between 'one particle and that immediately *above* it.'

"You state, and evidently quite correctly, that, supposing a vertical pipe 16 feet in length full of water to have the supporting base removed 'it would be emptied by the fall of water in one second, the final velocity of the water on issuing from the pipe, would be 32 feet per second, and the mean of the initial and final velocities would be 16 feet per second.' This is evidently quite correct. The whole column of water falls like a block of marble; the upper and lower parts are equally subject to the action of gravity, and every particle of water descending equal spaces in equal times, the whole column will fall at once, and this even without supposing that 'each particle coheres to the particle immediately above it,' and quite independently of cohesion, except, of course, what I may term, lateral cohesion, or that existing between the particles of the same horizontal section. The momentum of such a column is, therefore, 16 feet multiplied by the weight of the water; but you also state that, if the pipe had not been permitted to empty itself, but had been maintained constantly full, the velocity of the column of water would be 16 feet, and the momentum consequently the same as in the former case. Would not this conclusion be sufficient to convince you that there is an error in your reasoning?

"In the first case, the momentum, according to your reasoning, is the same as in the second, when the pipe is maintained constantly full. Surely this must be wrong. The mistake appears to me to arise from your not taking into account that, the pipe being supposed constantly full, the water *must enter as fast* as it issues, whether this entering velocity is imparted to the water by the height of the reservoir or other force. If the height of the reservoir or other force, which supplies the pipe with water, is not sufficient to impart to the entering water a velocity equal to that due to the *whole* height of the pipe, then, I maintain that the height of the water in the pipe will diminish proportionally, so as to regulate the issuing velocity according to the supply. I shall endeavour to explain this. No doubt, still supposing the pipe to be constantly full, and, as before, to be 16 feet in length, in the *first* second, the mean velocity will be only 16 feet per second, but for the remainder of the time, the velocity will be 32 feet per second, as will be apparent by carefully considering the following explanation.

"Let us first examine the velocity of the water at different points of the pipe in the first case; when the pipe being supposed full, and the supporting base removed, the water is allowed to fall freely, according to the law of gravitation: that the velocity at any point varies as the square root of its distance from the top of the pipe. At one fourth of the height, the velocity of the water, therefore, will be 16 feet per second; and at a foot from the top the velocity will be four feet per second; therefore, to keep a pipe one foot long constantly full, the water must flow in at the rate of four feet per second; and to maintain one four feet long full, the water must enter at 16 feet per second; if the reservoir does not supply water at this velocity, the pipe will not be perfectly full; and by analogy and following the same train of reasoning, we deduce that the pipe being 16 feet in length, the velocity will be 32 feet per second, and the water must enter the pipe at that rate. Suppose, for instance, the area of the pipe to be one square foot, if the reservoir supplies 32 cubic feet of water per second, then the pipe of 16 feet in length will be maintained constantly full; if the reservoir can only supply 16 cubic feet, then the pipe 16 feet in length will be maintained full only to one fourth of its height or four feet from the bottom; or let us suppose a glass tube 16 feet in length to be maintained full by pouring water from a jug, and let some colouring liquid, of the same specific gravity as water, be placed at the top, it will be found that as the colouring liquid descends, the velocity of the water poured in must be gradually increased until the colouring liquid has reached the bottom of the tube, when the velocity will be found to be 32 feet per second; during this second, therefore, the mean velocity will be 16 feet, and during the remainder of the time the velocity of the water to maintain the tube *full* must be 32 feet per second. If you do not pour in the water at this velocity, you will find, as I before stated that the tube will not be maintained full, but that the surface of the water will fall until the height of the filled part corresponds with the velocity of the supply.

"I trust I have proved even to your satisfaction that my reasoning on this point is correct. I have shown, from your own admission, viz., 'that the final velocity of the issuing water from the pipe in the first class, would be 32 feet per second, and the mean between the final and initial velocities 16 feet per second;' that to maintain a pipe 16 feet in length constantly full, requires the water to enter at the velocity of 32 feet per second, and, *vice versâ*, if the pipe be maintained constantly full, that the issuing velocity will be 32 feet per second. The above law is true of any body in vacuo; it is true of shot *in vacuo;* it would be true of shillings, in pleno, falling through a tube without friction, and fitting accurately the sides of the tube, so as to prevent the air from entering at the sides; they would also form a *rope,* and fall uniformly according to the same law, although there is here no *cohesion* in force; it is true from the mere effects of gravitation; but in order to keep up a continuous stream, if I may use the expression, the successive shillings must be dropped from a height such as to impart to them the velocity which the column has already acquired. In this case there is no cohesion, which causes 'one shilling to draw the one immediately above it,' and, therefore, why adduce this property of water to explain a fact when it can be accounted for by gravitation alone which acts on all bodies?

"I have already occupied so much of your valuable space, that I must defer bringing forward many illustrations of the above truths for some future period, hoping that you in the mean time will remember your promise, and enlighten us on a subject at present involved in so much obscurity. Since writing the above, I have met an authority of such eminence and celebrity on subjects of this nature, to support my views, that I cannot forbear quoting him at full length. The authority I allude to is Belidor, in the edition of his 'Architecture Hydraulique,' published at Paris in the year 1737, at page 170, paragraph 429 and 430, it is stated, 'that when a vertical pipe, of which the opening is equal to the base, is allowed to empty itself, the surface of the water acquires in falling a velocity which increases as that of bodies subject to gravity, which fall freely.' This is as you stated. In the next paragraph, 430, he states, 'As it is always possible to render uniform a retarded or accelerated velocity, in taking half of the greatest velocity, this must be done when we wish *to compare the discharge (la dépense) of a pipe, such as the preceding, with one always maintained full;*' and in paragraph 431, always alluding to pipes, 'the velocities of water are in the ratio of the square roots of the heights;' and further on he states that the velocity of the *issuing water* in a pipe *constantly full,* is that due to the *whole* height and not *half*; and also 'we can then, when it is convenient, substitute for the velocity of the water of the column, the square root of the height of the pipe.' I must conclude by requesting any of your readers who are not satisfied with my arguments, to peruse that part of Belidor from which I have quoted the above passages.

"I have the honour to be, Sir,

"Your obedient servant,

"T. F——N."

P.S. "In addition to the extracts which I have already given you from Belidor, I beg to add the following, in order to show more clearly that I have his support to my statement that the velocity is that due to the whole height. Chap. 3, paragraph 438, 'We can then say that the discharge *(la dépense)* of a pipe or reservoir during the time necessary for a body to fall freely from the height of the surface of the water above the bottom, is equal to a column of water which has for its base the orifice, and for height a line equal to the space which a body can move over with an uniform velocity during the time of the fall with the acquired velocity.' Apply this to a pipe of 16 feet; the time is a second, the acquired velocity 32 feet per second, and not 16 feet, as stated in your remarks.[1] Nothing can be more to the point than the above extract. It is true that Belidor has not remarked that the velocity of the whole column, if maintained full, increases every second, although it would appear that he was aware of the fact, from his statement in paragraph 573, when in treating of the momentum of water issuing from an orifice, he states that a pipe can never be maintained full by a reservoir unless the pipe be of such small diameter, that the friction retards the water more than gravity accelerates it.

Placing out of consideration for the present, the minor point respecting the cohesion of fluid particles, we shall confine ourselves

[1] It was the *mean* velocity we stated to be 16 feet per second, and not the final velocity.

strictly to the main question—the velocity of the water—and we shall endeavour to answer our correspondent's objections *seriatim*.

The first objection is founded on the momentum of the issuing fluid. We scarcely know in what manner it is intended to show the fallacy of our arguments, by placing the subject in that light. Our correspondent admits that the mean velocity of a column of water falling through a vertical pipe 16 feet long would be 16 feet per second, and surely if, as we contend, the issuing velocity of water from such a pipe kept constantly full be the same, the momentum in both cases must be equal. We do not see how this consideration proves any inconsistency in our arguments, nor that it gives any countenance to the view taken by our correspondent.

On the next point—the velocity of the water *entering* into the vertical pipe—the whole question may be said to depend. Our correspondent alleges that our "mistake" arises from not considering that the water must enter the pipe as quickly as it issues from it. We maintain, on the other hand, that his error consists in not considering by what force this velocity is imparted to the entering fluid. The water in the reservoir is, by the hypothesis, supposed only just to cover the upper end of the pipe; therefore the action of gravitation on the water between the surface and the top of the pipe can have no perceptible effect. The pipe is also supposed to be constantly full, and the fall of the water down it to be uniform. By what force, then, is the same velocity given to the water in the upper part of the pipe, as to that which has fallen 16 feet? Our correspondent asserts that the velocity of the water at the top of the tube is 32 feet in a second; but we are left completely in the dark as to the nature of the force by which this velocity, which is due only to a fall of 16 feet, can be communicated to the water flowing into the top of the pipe. According to our view of the case, the force which communicates the velocity to the entering water is derived from the action of gravitation on the water falling down the pipe. Part of the force acquired by the water in its fall towards the lower portion of the pipe is communicated to the more slowly moving water above. The tendency to accelerated motion is thus continually checked during the flow of the water by the loss of the motion communicated to the fluid in the upper portion of the pipe, and the accelerated is converted into uniform motion. The laws of dynamics teach, that when accelerated motion is rendered uniform, the resulting velocity is the mean of the initial and final velocities, or one half of the latter; therefore, in a fall of 16 feet, the accelerated motion being rendered uniform, the mean velocity will be 16 feet, which is half the final velocity acquired by a body falling from that height.

In the illustration of the glass tube, when our correspondent says that if the water be not poured in with a velocity of 32 feet in a second, the tube will not be maintained full, he appears to forget that water in pouring only obeys the laws of gravity, and that to pour it into a tube with a velocity of 32 feet in a second, it must fall from a height of 16 feet. In the illustration of the *rope of shillings*, it is plainly admitted, indeed, that in order to obtain a uniform velocity of 32 feet in a second, the shillings must be dropped from a height of 16 feet *before entering the tube*; therefore, even according to our correspondent's own illustration of his case, a fall of 32 feet instead of 16, is requisite to communicate a uniform velocity of 32 feet in a second. We may observe, in passing, that the illustration of the continuous fall of shillings could never be practically exemplified, for we cannot admit that a row of shillings, or of any other non-cohering bodies, would fall in a uniform stream unless they were all allowed to fall at the same instant of time, like a solid bar.

Towards the conclusion of his letter, our correspondent calls Belidor to his aid; and he appears to imagine that thus supported, his position is impregnable. For our own parts we do not see the utility in any course of original inquiry of relying on authorities, however celebrated, as guides where we are professing to take a new road which they have never trodden. If old authorities were permitted to decide new questions, all scientific researches would be limited to the compilation of different and various opinions, and to the decision of their relative values; and we should never advance beyond the present limits of knowledge. The argument of authorities has this further disadvantage, that the opinions quoted very frequently refer to circumstances different from those to which they are applied, and errors thus originating become the more dangerous by the apparent sanction of authorities, which are, if properly understood, opposed to them. The apparent contradictions in the quotations from Belidor, cited by our correspondent, are sufficient to show, either that they refer to different circumstances, or that Belidor had not paid special attention to the velocity of water in vertical pipes, but had, like most other writers, assumed without consideration that the efflux of water from vertical pipes is the same as through orifices. To show the contradictory nature of the opinions to be gathered from Belidor, on the supposition that his words apply throughout to vertical pipes and not to pipes and to orifices alternately, we will quote a passage preceding those referred to by our correspondent. In paragraph 424, he says, when speaking of the cause of the velocity of water flowing through orifices, and contrasting such discharge with the flow of water down vertical pipes, "as the force on the top of the water is absolutely nothing as compared with that at the bottom of an ideal column, corresponding in size with the orifice, it cannot be said that it is this column constantly renewed from the surface which flows out, but that, generally, all the water in the reservoir assists in the discharge through the orifice." He then proceeds to show that if a pipe were inserted in the orifice, and reached to the surface of the water, the exterior of the pipe would bear the pressure of the water in the reservoir, and that the water within the pipe would descend by its own gravity alone, unassisted by the pressure of the other fluid. The circumstances of the discharge in the two cases having been thus distinctly shown by Belidor himself to be so different, he could never mean to assert that the quantities discharged in each case are the same. It must be confessed that he has expressed himself in this part of his work rather vaguely; but M. Navier, who was deputed by the French Academy of Sciences, to superintend the publication of a new edition of Belidor's Architecture Hydraulique, in 1817, adds a note to these passages, from which it clearly appears that he considered Belidor to refer only to the discharge through an orifice, when stating the velocity to be equal to that of a body falling from the height of the fluid.

The authority of Belidor, therefore, would avail our correspondent nothing, even were we disposed to admit that it has any weight in the discussion of a question to be decided by reasoning from facts rather than by opinions. As the flow of water down a vertical pipe is assumed to be uniform, it is evident that there must be some other force than its own gravity which communicates to the water entering at the top of the pipe the same velocity as that which has fallen to the bottom and is flowing out. No attempt is made by our correspondent to show whence this force is derived, though according to his estimate of the uniform velocity, it must be equal to the pressure of another column of water of the same height as the pipe whence it flows. In our view of the case, the velocity of the entering water is derived from the gravitating force of the water descending the pipe; and as the accelerated motion of the falling fluid is thus converted into uniform motion, the velocity can be only the mean of the initial and final velocities of a body falling from the same height.

IRON DWELLING-HOUSE.—A large iron mansion has been built by Mr. W. Laycock, of this town, in separate plates. It is to be sent to Africa, where it will be used as a palace by one of the native kings. This singular building has three floors, exclusive of an attic. The basement story is 7 feet high; the second, 10 feet; and the third, in which is the grand suite of state apartments, is 12 feet high. In these his sable majesty will give his state audiences. The principal reception room, the presence chamber, is 50 feet by 30, and ornamented throughout in a style of most gorgeous magnificence. To counteract any annoyance from heat, the inventor has contrived the means of admitting a current of air, which can be regulated at pleasure, to pass through an aperture left between the outer plate and the inner panel.—*Liverpool Albion.*

TESSELLATED PAVEMENTS,

ANCIENT AND MODERN.

[A work has been recently published, at a great expence, under the direction of Mr. Blashfield, who is connected with the old established firm of Messrs. Wyatt, Parker & Co. the cement manufacturers, for the purpose of exhibiting to the profession what truly beautiful patterns may be adopted in tessellated and mosaic pavements, by the aid of the small porcelain squares recently introduced by Mr. Blashfield for that purpose. The work consists of ten elaborate designs by Mr. Owen Jones, the author of the "Alhambra," splendidly printed in colours. These designs cannot fail in directing the public taste to this admirable description of ornament, for the floors of halls, saloons, conservatories, baths, &c.—we may also add the aisles of churches; for to our taste, it is far preferable to the dingy encaustic tiles. The following essay on the materials and structure of tessellated pavements is by Mr. F. O. Ward who has devoted considerable research in collecting the information.]

The object of the following notice is to call public attention to a new material for tessellated pavements, and to an improved method of constructing the same, by the adoption of which this ancient and esteemed mode of decoration may be re-introduced, at a moderate cost, for the embellishment of our modern buildings. The improvements in question will, it is confidently believed, enable the modern architect to execute mosaic floorings, equal in point of extent and elaborateness to the most celebrated of the remains that have descended to us from antiquity, and very far superior to these in brilliancy and variety of colouring, in the accurate co-adaptation of the pieces, and in the uniform durability of the surface.

In order to arrive at a just conclusion on this subject, it will be necessary in the first place to bestow some attention on the materials and structure of the old Roman tessellated pavements, as described by Vitruvius, and still to be traced in the remains existing in various parts of the country, and in the specimens preserved at the British Museum.

The materials of the best and costliest pavements at Rome (such, for example, as those still remaining in the baths of Caracalla), are coloured marbles of various kinds, differing considerably from each other in hardness and durability. The inferior pavements, found scattered through Britain, France, and other parts of Europe, and along the northern coast of Africa, are usually made of such coloured stones as the neighbourhood happened to supply, with the exception only of the red tesseræ, which are almost invariably of burnt clay. Thus, in the celebrated Roman pavement which was discovered in 1793, at Woodchester, in Gloucestershire, the grey tesseræ are of blue lyas, found in the vale of Gloucester,—the ash-coloured tesseræ of a similar kind of stone, often found in the same masses with the former,—the dark brown of a gritty stone, met with near Bristol, and in the forest of Dean,—the light brown of a hard calcareous stone, occurring at Lypiat (two miles from the site of the pavement)—and the red tesseræ, as usual, of fine brick. These materials differ from each other in point of hardness even more than the coloured marbles of the costlier pavements at Rome; and it is evident that a surface composed of such heterogeneous materials must wear unequally at different parts, and ultimately fall into hollows wherever colours produced by the softer kinds of stone are employed.

If this remark should be met by a reference to remains of ancient pavements, discovered in this country after a lapse of sixteen centuries from their first construction, and still retaining a level unworn surface, it is obvious to reply, that the mere length of their duration gives no force to the objection, seeing that, during by far the greater portion of the time, these pavements have lain buried; and, further, that even when in use they formed floors to the baths and best chambers of the residences of Roman provincial governors, and were therefore, doubtless, subject to very inconsiderable traffic. The entrance hall of a modern club-house would afford a much more trying test of durability; and it will hardly be disputed that a pavement composed of heterogeneous materials would in such a position be liable to wear unequally.

The next point to be observed with reference to the Roman tesseræ, is the want of uniformity in their size and shape, and the consequent irregularity of their junctures, especially in the more minute portions of the design. Whoever will take the trouble to examine the choicest specimens of old pavements at the British Museum (as, for example, one presented by Mr. Lysons, which formed part of the Woodchester pavement referred to above,) will perceive that the tesseræ, instead of coming into contact by smoothly ground and equal sides, are in many places separated by broad uneven lines of cement. In some parts the intervals are of such width that the cement, which in a good pavement should be scarcely seen, forms at least a fourth of the visible surface. It is scarcely necessary to point out the effect which this net-work of brown cement lines, running through the whole design, and mixing a muddy hue with every tint, must have in diminishing the purity of the colours, and in deadening the sharpness and brilliancy of their contrast. It is much as if a picture, when finished, should be crossed and re-crossed all over with lines of brown paint.

Proceeding from these remarks on the materials of the Roman pavements to consider the mode of their construction, we shall find that, while the effect produced was imperfect, the means employed for its production were costly and inadequate to the end proposed.

Vitruvius, in the first chapter of his seventh book on architecture, after describing the manner in which the foundation of the pavement should be formed, goes on to say, that on the topmost layer of cement the tesseræ are to be laid—care being taken to keep the surface flat and true with the level; that, in the next place, all unevennesses and projections are to be worked down by rubbing and polishing; and that, lastly, a layer of cement is to be spread over the whole and scraped off again (in order, it would seem, to fill up any cavities in the cement between the tesseræ, and to render the surface as smooth as possible all over).[1]

We need not dwell at length on the time and trouble that it must have taken to set each tessera separately in the cement, and to try the surface with the level after every few pieces were laid. With respect to the subsequent operation of grinding down and polishing the surface of the work, it must have been in most cases (and particularly where stones of a hard and gritty nature were employed) the most tedious and laborious part of the process. We shall presently see that all these difficulties are obviated by the employment of the newly invented material and mode of construction, which we will next proceed to describe—taking, however, in the first place, a rapid survey of the various experiments which preceded this invention, and of the successive improvements by which it has been gradually brought to perfection.

About forty years ago, a patent was obtained by Mr. C. Wyatt for a mode of imitating tessellated pavements by inlaying stone with coloured cements. Floors thus constructed, however, were found liable to become uneven in use, in consequence of the unequal hardness of the materials; which defect prevented their general adoption. Terra cotta inlaid with coloured cements has also been tried, and found liable to the same objection.

During the last ten years, cements coloured with metallic oxides have been used by Mr. Blashfield to produce imitations of the ancient tessellated pavements; and, for work protected from the weather, the material appears to have answered tolerably well; but for out-door work, required to stand frost, it has been found necessary to employ Roman cement, the dark brown of which gives a dingy hue to all colours mixed with it. This, with some other practical difficulties, has interfered with the success of the plan.

Bitumen coloured with metallic oxydes has also been tried by Mr. Blashfield as a material for ornamental floorings. The groundwork of the pattern was first cast in any given colour, and the interstices were afterwards filled up with bitumen of various other shades. But this method was even less successful than the former; the contraction and expansion of the bitumen soon rendered the surface uneven; the dust, trodden in, obscured the pattern; and the plan, besides being ineffectual, was expensive.

Three years ago, Mr. Blashfield succeeded in constructing an extensive and elaborate inlaid pavement, on the plan of the Venetian Pisé floors. It was made after designs furnished by H. S. Hope, Esq., at whose country-seat Deepdine, in Surrey, it was laid down. It is still in good preservation.[2]

In the same year (1839) Mr. Singer, of Vauxhall, obtained a patent for a mode of forming tesseræ, by cutting, out of thin layers of clay, pieces of the required form, which are afterwards dried and baked in the usual way. His patent also included an improved method of uniting the tesseræ with cement, so as to form slabs of convenient size for paving. He has executed in this manner some very admirable mosaics, and his invention must be regarded as one of the most important steps towards the revival of the art in this country.

We now come to the discovery which led to the invention of the tesseræ particularly referred to throughout this treatise.

In 1840, Mr. Prosser, of Birmingham, discovered that if the material of porcelain (a mixture of flint and fine clay) be reduced to a dry powder, and

[1] This is the general sense of the passage according to the best commentators. The phraseology in the original is here very obscure and has probably suffered from the carelessness of early transcribers.

[2] A floor of a very similar kind was laid down at Mr. Hope's mansion, in Duchess Street, about sixty years since, and it is said to be still in excellent condition.

in that state be subjected to strong pressure between steel dies, the powder is compressed into about a fourth of its bulk; it then undergoes a process of semi-vitrification, and is converted into a compact solid substance, of extraordinary hardness and density; much less porous, and much harder than the common porcelain, uncompressed.

This curious, and as it has since proved, very important discovery, was first applied to the manufacture of buttons, to supersede those of mother-of-pearl, bone, &c. The buttons thus stamped out of porcelain powder are capable of resisting any pressure to which they are subject in use, and are more durable, as well as cheaper, than buttons of the materials ordinarily used.

The applicability of this ingenious process to the manufacture of tesseræ for pavements soon afterwards occurred to Mr. Blashfield; who made arrangements with Messrs. Minton & Co. (the manufacturers appointed to work Mr. Prosser's patent), for a supply of small cubes made according to the new process; these he submitted to various trials and experiments, and having found them in every respect suitable for the purpose, he has recently, in conjunction with Messrs. Wyatt, Parker, & Co., carried out the invention on an extensive scale. Tesseræ of various colours and forms—red, blue, yellow, white, black, brown; quadrilateral, triangular, rhomboidal, hexagonal, &c.—have been manufactured on this principle in large numbers; pavements of considerable extent have already been constructed with them; and they have been found to possess the following advantages:—

First, being formed in similar steel dies, they are of uniform size and shape, so that they can be fitted together accurately in the laying down of the most complicated designs. Secondly, being all composed of the same material, variously coloured, they are all of precisely equal hardness, so that pavements made with them are not liable to fall into hollows in use. Lastly, owing to the effect of the intense pressure under which they are made, they are quite impervious to moisture, of a flinty texture throughout, and, in a word, to all intents and purposes absolutely imperishable.

In these several respects, their superiority to the Roman tesseræ, (which, as we have seen, were shaped imperfectly by hand, and differed from each other in hardness,) must be manifest to the reader. Nor less conspicuous is the superiority of the modern process of uniting the tesseræ to form pavements.

For this purpose (instead of spreading the cement on the surface to be paved, and laboriously setting each single tessera in it, according to the directions of Vitruvius), the pavement is first put together, face downward, on a smooth surface, so that the tesseræ find their level without any trouble to the workman; and as soon as a sufficient portion of the design is finished, it is backed with fine Roman cement, which is worked in to fill the crevices between the tesseræ; the pavement is thus formed into smooth flat slabs of convenient size (according to Mr. Singer's method), and these are laid down on a foundation properly prepared in the usual way.

One peculiar feature of this process is, that private persons, if so inclined, may set out their own pavements in the coloured tesseræ, leaving it for a workman afterwards to cement and lay down the slabs. Fine mosaic work for the tops of tables, for illuminated monuments, &c., may be made in the same manner with a superior kind of tesseræ, glazed on the surface, and richly ornamented in gold and colours.

Pavements thus constructed are singularly beautiful. The outline of the design strikes clearly and sharply upon the eye, and the brilliant colours of the tesseræ are reflected from the level surface, uninterrupted by those broad uneven lines of cement, which in the Roman pavements detract so much from the general effect. The truth of every line and angle in the figure, and the just proportion of all its parts, however complicated and various, impress the mind with an agreeable sense of order and precision. Such, indeed, is the exactness and facility of the workmanship in these pavements, that the oblique and intricate intersections of the Mauresque designs are as readily executed as the simple rectangular patterns of the Pompeiian style. Even the scrolls and twisted guilloches, the quaint emblematical devices, and grotesque representations of horses, warriors, &c., found in the most elaborate of the Roman pavements, may be accurately imitated with the new stamped tesseræ.

The Roman designs, however, have little to recommend them to the modern artist, beyond their historical interest. Even the earliest of them, which are the best, were produced subsequently to the Roman invasion of Greece, when art was everywhere declining; and they abound with indications of the extravagant and licentious taste which grew up amidst the general corruption of Roman manners, occasioned by the rapid influx of foreign wealth and foreign habits of luxurious excess.

When designs after the antique are required, the elements of them should rather be sought in the beautiful decorations of the Etruscan vases, and in the admirable remains of Greek art in general, during its best period—*i. e.* from about 400 to 200 B.C. or during the time of Phidias, Praxiteles, and their immediate successors. (Such are the models which have guided the composition of the magnificent tessellated pavement designed by Mr. Barry, and executed under his direction by Mr. Singer, for the hall of the New Reform Club; a pavement so beautiful and so generally admired, that it can hardly fail to give an impulse to the re-introduction of mosaic decoration, hitherto so sparingly employed by modern architects.)

For Mauresque designs, the mosaic dados of the Alhambra may be advantageously consulted. They are executed in glazed earthen tiles, variously coloured, shaped with considerable exactness, and joined with cement. They present many examples of ingenious arrangement and well-contrasted colouring.

But, whichever of these various styles the architect may adopt, he will find that, for the realisation of his conceptions, there is no material which presents so many advantages as the compressed porcelain tesseræ—whether on account of their uniform size and shape—the purity and brilliancy of their colours—or their extreme hardness, and unalterable durability.

NEW CHURCHES.

[At the request of several architects residing in the country, we give the following "*Suggestions and Instructions, as amended May*, 1842," of the "INCORPORATED SOCIETY FOR PROMOTING THE ENLARGEMENT, BUILDING, AND REPAIRING OF CHURCHES AND CHAPELS."]

1. *Site.*—Central, with regard to the population to be provided for; dry; if possible, rather elevated, but not on a high or steep hill;—not near nuisances, such as steam-engines, shafts of mines, noisy trades, or offensive manufactories;—accessible by foot and carriage-ways, but not so near to principal thoroughfares, as to subject the service of the church to the danger of being incommoded by noise. The building to stand east and west as nearly as possible.

2. *Style and Form.*—No style seems more generally suitable for an English church than the Gothic of our own country, as developed in its successive periods. The Norman (or Romanesque) style is also suitable, and offers peculiar advantages under certain circumstances, especially when the material is brick. The Society earnestly recommend that, in the proportions and great features, as well as in the details, good ancient examples should be closely followed.

For Gothic churches, the best form is either the cross, consisting of a nave, transepts, and chancel, or the double rectangle, composed of a nave, with or without side aisles, and of a chancel. In a chapel, the single rectangle is also suitable; the length being *at least* twice as great as the breadth. If the funds do not suffice to complete satisfactorily a design, otherwise eligible, or if the circumstances of the neighbourhood render it probable that, at no great distance of time, the building may be enlarged; it is better to leave a part of the original design, as, for example, side aisles or transepts, to a future period, than to attempt the completion of the whole design at once in an inferior manner. In such a case, the temporary walls and fillings up of arches should be so built, as clearly to show that they are temporary, and that the building is incomplete, but at the same time not without due regard to ecclesiastical propriety.

3. *Foundation.*—To be surrounded, if requisite, by good covered drains. If the soil wants firmness, the walls may often be better secured from partial settlements by spreading the footing on each side, than by deepening the foundation, or resorting to more expensive works.

In all irregular or doubtful soils, concrete is recommended for the foundations, in preference to any other material.

No interment should be permitted under a church, except in arched vaults properly constructed at the time of building the church, with entrances from the outside only; nor should any graves be made within 20 feet of the external wall.

4. *Area.*—It would tend much to the preservation of churches, and render them more dry, if a paved opened area, not less than 18 inches wide, were made round them, and sunk 6 or 8 inches below the level of the ground about the church, with a drain from the area to carry off the water. Or the same objects might be attained either by turning a segmental arch from the wall outside the footing, or by bedding in the wall a course of slate in cement.

5. *Basement.*—The inequalities of the ground, the dampness of the soil, &c. often render it desirable to have crypts under a church. They should be of a massive construction, turned upon semicircular or segmental arches, resembling the early examples, entered only from without.

6. *Floor.*—To sittings, wood; to open spaces, or chancel, stone or encaustic tiles. If not undervaulted, it may be freed from damp by brick rubble, flints, ashes, or furnace slag, laid to the depth of 12 or 18 inches under the floor. Allowance should also be made for the future rise of the surrounding burial ground; the floors of many churches, originally above ground, are at this day many feet below the surface, and have thereby become damp and unwholesome. It is desirable that the church floor should be raised at least three steps above the ground line.

The distance between the joists of the floor should never exceed twelve inches.

All wood floors should be supported on walls, with a clear space of eighteen inches in depth, well ventilated beneath.

No American timber to be used either in the floors or any other part of the building.

Flagged floors should be laid on cross walls eighteen inches high.

7. *Walls.*—To be solidly constructed of stone, either squared, or rubble, or flint; or of brick, where no good stone can be procured without great additional expense. If the walls are of brick, cased with stone or flint, the stone or flint to be well bonded into the brick. As a general rule the thickness must not be *less* than as follows:—

	Square stone of the best quality, or brick.	Brick faced with Flint or Stone.	Inferior stone, Flint, or Rubble.
	ft. in.	ft. in.	ft. in.
If less than 20ft. high, and carrying a roof not exceeding 20ft. span	1 10½	2 0	2 3
If 20 ft. or more high, or carrying a roof exceeding 20 ft. span	2 3	2 5	2 6
If more than 30 ft. high	2 7½	2 9	3 0

The above dimensions are given on the supposition, that there are buttresses, of solidity and form suitable to the style adopted, placed opposite the trusses or principals of the roof; where there are no buttresses, the thickness of the walls must be considerably greater.

No cement or plastering of any kind to be used as a facing of the walls, or of any external part of a church or chapel.

If a wall be built with two faces of stone, filled between with rubble, great care must be taken that they be properly bonded together, as the wall will otherwise not stand a partial settlement. Where good stone is scarce, a thickness, otherwise perhaps unattainable, may be secured by this method of construction.

Walls built of flint or rubble should have bonding courses of stone or brick, and stone or brick piers at intervals, approaching at least within four inches of the external face.

Whatever be the material of which the substance of the walls is made, the dressings should, if possible, be invariably of stone.

The greatest attention should be paid to the quality of the mortar used.

8. *Roof.*—The best external covering is lead, which should be not less than seven pounds to the foot;—or copper of not less than 22 oz. to the foot. Blue tiles, commonly called Newcastle tiles, or stone tiles, are perhaps the next best covering. Westmoreland slates are better in colour than those commonly used, but are, in most cases, expensive. All slates to be fixed with copper nails.

Flat ceilings are inconsistent with Gothic architecture. Next to a stone vaulted roof, none has so good an effect internally as an open roof, exhibiting the timbers. It is desirable that this should be of high pitch, the transverse section forming or approaching to the figure of an equilateral triangle.

If a wooden panelled roof be preferred, the panelling should not be made to imitate stone.

In roofs of low pitch and wide span, horizontal tie-beams are necessary; but in other cases, where the Society is satisfied that due provision has been made for the safety of the construction without them, they may be dispensed with.

If the distance between the principal trusses exceed ten feet, intermediate trusses must be introduced. The distance between the common rafters should never exceed twelve inches.

Wherever the ends of timbers are lodged in the walls, they should rest in cast iron shoes or on stone corbels.

9. *Windows.*—In Gothic churches, where stained glass is not used, the glass should be in small panes, those of a diamond shape being generally preferable.

Hopper casements are recommended, and they should be inserted in almost all the windows, in order to secure due ventilation.

Where lead lights are adopted, copper bands to tie them to the saddle bars are preferable to lead, being less liable to stretch and become loose by the action of the wind.

The very unsightly appearance often occasioned by the wet streaming down the window backs, can be prevented by fixing a small copper gutter at the bottom of each lead-light, to receive the moisture produced by condensation, with copper tubes to convey the same to the outside of the building. This has also a tendency to keep the building dry, and to preserve it from decay; or the inside of the sills may be raised an inch and a half.

A good effect will be produced by keeping the sills of windows raised as much as practicable above the line of the tops of the seats.

10. *Tower and Spire.*—The usual place of the tower, in a church without transepts, is at the west end; or it may be placed about the middle of the side. If funds are scanty, it is better to leave this part of the church to a future period, than to attempt its immediate completion in an inferior manner.

When the tower contains more bells than one, the timbers of the bell framing or floor should not be inserted into the main walls, but should be supported either on set-offs or on corbels.

11. *Gutters.*—Where necessary, to be most carefully constructed to carry off the rain and snow into the perpendicular pipes, which are best of cast iron, cylindrical, and placed an inch or two at least from the wall, so as to admit air and keep it dry.

Dripping eaves projecting very far do not in all cases supersede the necessity of gutters and pipes, even in very sheltered situations; but in exposed places, eaves-gutters, and rain-water pipes will be absolutely necessary to prevent the wet being driven against the walls, and thus rendering the building damp.

Eaves gutters may be made of cast iron; but, unless very skilfully cast, they will not preserve their level.

The lead for gutters must not be less than eight pounds to the foot.

Lead gutters must not be less than twelve inches wide in the narrowest part, with drips at proper intervals; each drip two inches deep at the least, and the fall between the drips not less than one inch and a half in every ten feet.

Outlets to be provided in parapets to carry off the overflowing occasioned by rapid thaws or otherwise.

Drains on the roof should be protected by coverings, as it prevents the melting snow from congealing in the gutter, and thus obstructing the water-course.

Drains should be formed at the feet of all the rain water pipes.

12. *Ventilation.*—Ventilation cannot be always completely effected by windows alone, without incommoding the congregation. In such cases foul air may be expelled at or near the roof, either by horizontal or perpendicular channels or tubes.

Where there is a ceiling, apertures should be made in it for the proper ventilation of the roof.

All the original provisions for the ventilation of the building must be carefully looked after, and the apertures kept open.

13. *Chimneys.*—If any be required, the utmost care must be taken to render them safe from fire. They should never be brought within eighteen inches of any timber. They should be as unobtrusive as possible, but not disguised under the form of any ornamental feature of the building.

14. *The Lord's Table.*—Should be raised two or more steps above the floor of the chancel, which should itself be raised a step or two above the floor of the nave. Where the rails do not extend across the chancel, no seats should be allowed between the rails and the north and south walls; and as much room as possible should be left about the rails for the access of communicants.

15. *Font.*—To be fixed at the west end of the building, or as near as convenient to the principal entrance, but not so as to be under a gallery. Care to be taken that sufficient space is allowed for the sponsors to kneel. The font to be of stone, as directed by the Canon, and large enough to admit of the immersion of infants. To be provided with a water drain.

16. *Reading Pew and Pulpit.*—The reading pew should not be so elevated as to resemble a second pulpit; and both reading pew and pulpit should be so placed as to intercept the view of the east end as little as possible from the body of the church.

17. *Seats.*—The seats must be so placed as that no part of the congregation may turn their backs upon the altar. There must invariably be an open central passage up the whole length of the church, from west to east. No square, or round, or double pews can be allowed, and as few pews as may be. Much accommodation is gained by the adoption, instead of pews, of open seats with backs.

The distance from the back of one seat to that of the next must depend in great measure on the height of the backs and the arrangements for kneeling. Where the funds and space admit, convenience will be consulted by adopting a clear width of 3 feet, or even 3 feet 4 inches; but the width of 2 feet 6 inches in the clear may be allowed if the back of the seat be not more than 2 feet 8 inches in height. This height is in all cases to be preferred, both for convenience and for appearance. If a greater height be adopted, the distance from back to back must not be less than 2 feet 11 inches in the clear. There should not be any projecting capping on the top of the backs. Means for kneeling must in all cases be provided. Hassocks are to be preferred to kneeling boards, especially where the space is narrow.

Twenty inches in length must be allowed for each adult, and fourteen for a child. Seats intended exclusively for children may be twenty-four inches from back to front.

18. *Galleries.*—None can be permitted in any part of the chancel. Where necessary, they should not enclose the columns against which they rest, so as to break the upright lines of the shafts from the floor to the roof. Wherever placed, they should, as much as possible, be made to appear as adjuncts and appendages to the architectural design of the interior, rather than as essential parts or features of it. The Society will not sanction any plan involving the erection of a gallery, unless in cases where it is distinctly shown that no room is unnecessarily sacrificed, by inconvenient arrangements, on the floor.

19. *Vestry.*—The vestry should have access to it from without.

20. *Finishings.*—Wall wainscoting, or wood linings to walls, to be avoided wherever convenient. Wood linings to walls confine the damp, and frequently occasion dry rot. For the same reason cement skirtings are to be preferred to wood, particularly on the ground floor. Where the linings to the walls are of wood, holes should be perforated under the seats to allow the circulation of air. As it is scarcely possible to prevent rot if any wood is in contact with the walls, the ends of seats next the walls should be omitted, and cement, painted, be substituted.

21. *Exciseable and Customable Articles.*—Architects are particularly desired to take care that an accurate account be kept of the quantities of customable and exciseable articles used, where the expense of enlarging or building a church or chapel will amount to £500 or upwards, such as may be duly certified or verified by affidavit.

MR. VIGNOLES' LECTURES ON CIVIL ENGINEERING, AT THE LONDON UNIVERSITY COLLEGE.

SECOND COURSE.—LECTURE XVII, AND LAST; FOR WHICH WE ARE INDEBTED TO THE "MINING JOURNAL."

Before proceeding to a summary of the second course, Mr. Vignoles observed, that there was a material point connected with the subject which had not been sufficiently discussed—viz. the motive power to be employed; on this greatly depended the principles on which a line of railway should be laid out, the end and object being to convey the greatest extent of traffic at the least cost: this cost was compounded—first, of the interest of the capital expended, which should be considered a constant charge; and second, of the periodical working expenses—the work to be done being summed up in the general expression of "overcoming all obstacles to facility of motion." What are these obstacles? They might be divided into two great heads—Gravity and Friction. 1st. Gravity is a natural cause existing under all circumstances, and, affecting lines deviating from the horizontal, in direct proportion to the sine of the angle of inclination. Engineers, therefore, have considered that the first principle in laying out roads, should be (under limits) to approximate as nearly as possible to the horizontal, in order to exclude one of the great causes of obstacle; since, with maximum loads, the retardation arising from gravity is most felt. When such could not be effected, then to distribute the total rise (or effect of gravity) along the easiest ratio of slope. But, in practice, the occurrence of maximum loads, in ordinary passengers and merchandise traffic, forms the exception, instead of constituting the rule, and it is only when a regular and constant heavy trade is to be anticipated that horizontal communications should be insisted on. 2nd. Friction, is a physical cause, varying according to the perfection of the road and of the vehicles moving on it. In the practical working of a railway, however, so many expenses arise under the heads of "conducting traffic, management, &c." common to most lines, whatever the gradient, that they tend to make the cost of overcoming friction and even gravity (particularly with the ordinary light loads) but a small fraction of the total charges. Comparing the amount of obstacles on a railway with that on the ordinary road (where the friction, meaning thereby axletree friction and surface resistance, may be called sixteen to twenty times greater than on a railway), and assuming the inclination on railway and road to be the same, the general result is that the perfection of the railway surface moved over, and the improvement of carriages, or rather that of their wheels and axles, cause the effect of gravity to be felt in the most sensible degree on railways; while the imperfection of the road causes it to be comparatively scarcely appreciated Hence with the wretched surfaces of the old roads, and the clumsy wheels of our primitive vehicles, the hills seem to have scarcely added to the obstacles to be overcome. As the road surfaces and carriages improved, and increased speed and heavier loads were introduced, the necessity for the greater perfection of the ordinary road became apparent, and the remedy was applied in various degrees during the last 100 years until it was completed as far as possible, in the extensive improvements by Telford and Macneill on our great highways. But in carrying out this principle on railways we have run into the opposite extreme. We should first take in one sum the retarding causes of gravity and friction—viz., the friction. being constant, or nearly so, putting aside the resistance of the air at high velocities, varying only in the perfection of the wheel axles, and in the mode of lubricating, (the surface resistance on railways being, practically speaking, nothing), and the maximum gradient, or rather the gravity due to it:—their sum will be the constant divisor for the motive-power, of whatever description that motive power might be; and, in considering the latter point, it must be the distribution of the traffic, or what may be called the average hourly load throughout the year which is to determine the question. In many instances, in this point of view, it would probably often be found most economical to use animal power, (as is done on the Edinburgh and Dalkeith Railway), were not velocity required—which, on railways, enters so materially into the calculation, that mechanical power in some shape becomes necessary; and this divides itself into stationary power, or when the mechanical means are fixed, and locomotive power, or when the machine travels along with the load. There are two serious difficulties connected with the latter system;—first, a great addition to the load, equivalent on the average to doubling it; and next, that the fulcrum through which the motive power must be transmitted —that is, the rail on which the locomotive driving wheel impinges—is greatly affected by atmospheric causes, occasioning great variation in the adhesion, and consequent uncertainty from slipping of the wheel, so that, as explained in a former lecture, the load after a locomotive engine is really limited by its adhesive power, and not, as might at first be supposed, either by the cylinder power or boiler power. Considered abstractedly, stationary power is cheaper, and always would be so if the traffic were certain and regular, with maximum loads and very moderate speed, even with the present obstacles of ropes, sheaves, and all their contingent complicated apparatus; but at high speed, with a great length of rope, the experience of the working of the Blackwall Railway has shown that for passenger trains only, there was, compared with the most expensively worked lines on the locomotive system, to say the least, no economy in the motive power, though other conveniences arising from the peculiar arrangements on that line, were, perhaps, in this special case, more than an equivalent. A most serious obstacle to stationary power, was the necessity of absolutely stopping, and disengaging and refixing, the trains at each station, which stations could not be conveniently, and certainly not economically, placed further apart than three or five miles, for it could readily be proved, than on a continued distance of six or seven miles of railway worked by a rope, the power of the largest engine that could well be erected, would be absorbed in moving the rope only. The Professor then went largely into a consideration of applying stationary engines as the motive power in working inclined planes under a variety of circumstances, and recommended to the students to consult the valuable work of Mr. Nicholas Wood on this subject, and indeed on all the details of railway working, of which, particularly in the third edition, there was most of the latest information. In many situations, however, where water power could be obtained, the stationary rope and pulley system might be advantageously introduced. Gravity became the motive power, on what were called self-acting inclined planes; that is, when the gravity of a descending train of laden carriages brought up a train of others empty or partially laden; or where skeleton wagons, or water tanks on wheels, could be used as artificial counterbalancing weights in either direction alternately; the circumstances under which self-acting inclined planes could be properly introduced were rare. Mr. Vignoles then gave a clear account of various modes of working self-acting inclined planes; among these was described a curious and interesting one near the great limestone quarries in North Staffordshire; another on the St. Helen's and Runcorn Gap Railway, which he had himself put up, and also the planes for the Great Portage Railway, across the Alleghany Mountains, in the United States of America. Stationary power might also be used to a greater extent on the atmospheric system, whereby, to speak metaphorically, a rope of air was substituted for a rope of hemp or wire, and where no pullies were required, nor any necessary stoppage at the intermediate engines, where only the carriages had to be moved, and where nearly the whole dynamic force generated was made available for motive power. This system had already been explained to the class, and practically illustrated on a railway thus worked, and need not be further alluded to. The Professor was preparing for publication a separate lecture "On the Atmospheric Railway System," to be illustrated with plates, and tables, and appendices, in which that interesting subject would be fully gone into, and all the mathematical and philosophical investigations given, with estimates of the cost of such railways under various circumstances of traffic and gradient; fully enabling the value of the principle, as a motive power, to be appreciated. Although modern practice had almost discarded the use of animal power from railways, it might be proper to refer cursorily to it. A horse seems adapted to drag vehicles, from the mode in which he adjusts his muscular action, so as to throw the greatest effect on the line of draft; in making an effort to draw a carriage, the body of the animal is bent forward, throwing upon the latter the part of its weight necessary to overcome the resistance, the muscular force of the legs being employed in keeping up his traction and moving the body onward; the effort of the animal being resolvable into these two parts—viz. the action on the load, and that required to move itself by. It may be gathered from writers on this subject that the force a horse is capable of exerting, is that equal to about one-seventh or one-eighth part of his own weight: or that, on an ascent of one in seven or one in eight, the exertion required to overcome his own gravity, is a force equal to that he is able to exert on a load on a level plane. Taking the average weight of a horse, and considering that he is capable of occasionally exerting great extra power on the load, still it seems to be satisfactorily ascertained, that nearly seven parts out of eight of the muscular power of a horse is required to drag his own weight forward, leaving, of course, only one part applicable to the load. But the criterion of a horse's power in practice is not the occasional effort of which the animal is capable at a dead pull, or for a short period: we must estimate his strength by what he can do daily, and day after day for a long period, and without breaking him down prematurely. If a horse is to travel at the rate of 10 miles an hour, his power of pulling is greatly diminished, and he can work only an hour or so in the day: at two miles an hour he may give out a power of 150 lb. on the load: at 10 miles he has scarcely 35 lb. to spare, and at 12 miles an hour, he can seldom be expected to do more than move himself. This was on the average of horses—all beyond were exceptions Thus, the application of horses to railways as the motive-power was very limited: and in laying out lines where they are to be used, to full effect, gravity should be arranged to be always with the load, or, at least, not against it; the rate of travelling only 2 or 2½ miles per hour, and the traffic uniform. Mr. Vignoles proceeded to an interesting comparison between locomotive and stationary power up inclined planes, taking the inclination of 1 in 50 as a maximum, and showed that *when the traffic was small, and the loads consequently comparatively light, and the daily number of trains not great, locomotive engines*, as the motive-power, (taking into consideration all circumstances of first cost, and working expenses—particularly the latter, of which the locomotive power was but a small part), *would not be so expensive as stationary engines*, while they would be certainly more convenient; and that, with all the best modern improvements in the locomotive engines, the system of working with large cylinders, using the steam expansively on the level and falling parts of the railway, improved boilers, &c., *planes of 1 in 50 might be practically worked:* the only material drawback being, occasional slipping of the wheels on the ascent, and the necessity of great caution and careful application of the brakes on descents; but on the whole, the balance, *under the above circumstances*, was much in favour of the locomotive system. The Professor then entered into a very long and minute comparison of the present system of working the Blackwall Railway by stationary engines, with ropes and pullies, with what would be the case if the motive power were locomotive engines—and by tables, showed that while the working of the Blackwall Railway (3½ miles) on the stationary system, was costing about *seventy-two pence* per mile per train, the cost of working the Greenwich Railway (3¾ miles) was only about *forty pence*:—but, Mr. Vignoles admitted, that by the former, great accommodation to the public was afforded by the numerous intermediate stations, while on the latter, there was only one stoppage. In concluding the general comparison between the two principles of mechanical motive-power, the Professor observed that on the locomotive system, a minimum of power need only be provided in the first instance and the number of engines might be increased gradually as the traffic required, which was a great consideration when the first expenditure of capital had to be kept down to the very lowest terms, at all future risks. On the stationary system, provision had to be made, from the outset, for the maximum anticipated trade, which of course increased the first outlay on the railway establishment, and depended on the ultimate economy of future working to make up the difference. Having concluded the notice of various descriptions of *motive-power* employed on railways, of which the preceding is but a mere outline, some general remarks were made on the principles of laying out railways, in reference to the several systems respectively.

In a concluding general summary, Mr. Vignoles observed, that in his first course, at the latter end of 1841, he had fully considered the practical rules for earthwork and constructions:—these were not peculiar to railways; the theory and practice of bridge-building, applied to all internal communication, and would be most conveniently considered in a separate illustrated course, but he wished to recall to the class generally, that in proceeding to lay out railways in the first instance, the engineer ought to enter much more deliberately into those previous inquiries, so absolutely necessary, than had hitherto been done. A system of applying the same general rule of perfect gradients alike to lines, of the least as well as of the greatest traffic, had too much prevailed, and until more rational ideas were substituted, the public would shrink from embarking in enterprises subject to all the contingencies of extra cost beyond estimates which had characterised almost every railway in this country. *The earthwork and its consequences*, regulated the cost, particularly as regarded contingencies, and the utmost consideration should be bestowed as to how far it was justifiable to encounter the expense of these operations. The average cost of earthwork, and all consequent works of art, &c., on the English railways was nearly £15,000 per mile, or about 50 per cent. of the whole capital expenditure. Mr. Vignoles was decidedly of opinion that in *all future lines in this country, and particularly on the continent*, the corresponding outlay *ought not to exceed £5000 per mile*, and that beyond that sum perfection of gradient would be bought too dearly. In reference to the *gauge* of railways, Mr. Vignoles stated, distinctly, that theoretical investigations and practical results led him to consider a six foot gauge the best; but the present 4¾ foot gauge was certainly rather cheaper. In respect of *curves*, he observed, that they were much less disadvantageous than had been first supposed: that a half mile radius was now everywhere admitted; and that he himself did not hesitate to adopt a quarter mile radius whenever expense could be materially saved; and if the atmospheric system of motive power should be found to succeed on a large scale, the curves might, on lines thus worked, be safely made still sharper. In regard to the systems of constructing the *upper works*, he had in a recent lecture, entered so fully into the comparison, that he need only now say, that if the expensive and complicated system of heavy rails and chairs, and cross sleepers, were preferred by engineers, then the ingenious improvements of Mr. May, of Ipswich, in chairs and fastenings, applied by Mr. Cubitt on the South Eastern (Dover) Railway, with great care in laying, draining, and ballasting, made *that system* perfect and complete. The Professor, however, decidedly gave the preference to the less costly, and the more simple system of lighter rails, without chairs, laid on continuous longitudinal balks of timber of sufficient scantling, and fastened on Evans's principle, modified in the manner shown by the models exhibited to the class; and several engineers were adopting this opinion. On the continent of Europe, where iron was dear, and timber cheap and abundant, Mr. Vignoles calculated *a saving of full £2000 per mile of double road would accrue from the adoption of the latter system*—which offered a vast national economy. In reference to the subject of working drawings, plans, and sections, the Professor reminded the class of the importance he attached to having all such previously made out on a large scale, that the cubic quantities might be accurately obtained, and the just prices considered; and thus, in proceeding to make the estimates, nothing would be left to conjecture, and as little as possible left to be afterwards altered. The period of time for the execution of the works should be extended as far as consistently could be done. The two great sources of the extra expenditure on railways had been, the extreme haste with which the works had been pushed on, and the changes of every kind from the original designs. These points being all carefully considered, *even before the plan was brought before the public in general*, the estimates might be better depended on. Mr. Vignoles then went through all the great items of expenditure generally arising on first construction, and explained how the accounts of measurements should be made out and kept under very distinct general heads, subdivided into minor items, from the purchase of the land to the last finish to the stations, and the entire fitting up and furnishing of the carrying establishments. Sufficient experience had been attained in all these matters to enable the engineer, in future, if the above rules were faithfully followed out, to place himself beyond all chance of reproach for making erroneous estimates. In conclusion, the Professor observed, that he had selected *railways* at the request of the class, as the theme for the course just concluded; but although so much consideration had been given to the subject, he had only been able to touch in a very general way upon the chief points; yet it was to be hoped a sufficient idea had been given of the principles of construction, and of their general application, to create an interest in their minds. Should any of the students hereafter be employed to execute a railway, he trusted they would recollect these lectures with advantage, while they would also probably better understand and appreciate them: at the same time, he must not neglect to impress upon them, that it was not at the college, in the lecture-room, or even in the office of an engineer, that all the duties and knowledge necessary could be taught: the young aspirant must pass much time in the work-shop, indeed, he must become a workman, and acquire the use and skill in the handling of tools, and the erection of mechanism of every kind—and passing to the actual works, ought to learn to be able to direct personally the labour of the mason, the carpenter, and the smith. "Above all," said Mr. Vignoles, "the student in engineering must carry into life with him the constant remembrance of what I have so repeatedly enforced, that the reputation of an engineer in this country is based upon the success of his works, of his mechanism, and of all the efforts of his mind and hand, in respect to, and in proportion to their being productive of commercial and beneficial results, to those who, at his suggestion, may undertake to provide the necessary funds: and he should consider how this result can be best obtained, rather than study the splendour of his undertakings. It is for the architect to attend to the decorative and the beautiful; it is sufficient for the engineer to study proportions, and rely on the simple grandeur of his works as a whole. It is related that Napoleon once observed to the celebrated Carnot, "*Lés ingenieurs doivent toujours avoir des idées magnifiques;*" this is true as to their first conceptions, but in the realization, they must be sobered down by the rules of economy and judgment. After the first burst of talent, after image and form has been given by the hand to the bright idea emanating from the brain, let it be brought down to practical application only after a strict inquiry into the cost. Remember what I quoted on a former occasion, when contrasting the two celebrated light houses, the *Eddystone*, and the *Cordouan*—no unfit emblem of the two celebrated engineers who erected them may I venture to add of their respective nations—remember, I say, "*'tis use alone that sanctifies expense.*"

ROYAL ACADEMY.

Professor Cockerell's Lectures on Architecture.

(From the Athenæum.)

Lecture V.

The love of fine art, and the lively discussion of its principles, which occupied the wits and the courts of Italy in the 15th and 16th centuries, employed the solitary reflections of literary philosophers in the 18th; and in 1730, Baumgarten suggested the title of æsthetics, by which these studies have been designated ever since, and many works remarkable for ingenious criticism, learning, and taste, have resulted. These may be ranked in two classes. The first resolves the questions of taste directly into an original law of our nature, implying senses by which the qualities of beauty and sublimity are perceived and felt as their appropriate objects; it is this species of hypothesis to which artists and amateurs chiefly resort. The second class of hypothesis arises from the opposite view of the subject: resisting the idea of any new and peculiar sense distinct from the common principles of our nature, this class supposes some one known and acknowledged principle or affection of the mind to be the foundation of all the emotions we receive from the objects of taste, and resolves them into some more general law of our intellectual or moral constitution. Thus Socrates and Hume, and others, resolve them into our sense of utility—Aristotle and St. Augustine, into order and design—Diderot and Allison into relation and association. But though in such discussions we recognize many truths, the partiality of individual views renders them often dangerous.

> When a philosopher can find
> Some fav'rite system to his mind,
> In every point to make it fit,
> He'll force all nature to submit.

Language itself fails in defining those phenomena which elude ordinary observation, and even when it approaches definition, the measure of quantity, and quality, and circumstance, can alone be adjusted by the magician genius.

The æsthetical principles of architecture, as handed to us from the Greeks by Vitruvius, concur with the notions of ancient philosophy, and have not been controverted by the modern; and though subjected of late years to some rude attacks, they have never been superseded, and we can follow no better text-book in the consideration of our subject. Those principles apply to every style and invention of architecture which the world has hitherto known; they belong to our physical and intellectual nature, and will never change but with an alteration in these.

When the works of Vitruvius were first discovered, they were accounted a revelation to the craft, and called "divine" by Sulpitius, the first translator; and, nearly 200 years after, Perrault, in his translation, calls them "a very singular piece, and an inestimable treasure in the opinion of the learned." Eighteen translations, in 41 editions, are enumerated to this day. In 1807 the philologist Schneider republished Vitruvius. "My whole scope," says he, "has been to purify the text, so as to enable men learned in art to reconstruct and understand the theories of Vitruvius, hitherto obscured by interpolations and vicious translations." But he detracts from the merit of his work by a severity of criticism, as uncandid as it is derogatory to the character of his author. He declines his apology, as "writing neither as an accomplished philosopher, an eloquent rhetorician, nor as an expert grammarian, but as an architect, laying down rules useful to those who build." He calls his language obsolete and plebian, accuses him of pride and envy, and rates him as a morose, inept, infirm old man, querulous and vulgar. But Schneider was the less justified in such treatment, as being weak upon those points in which his author was most strong, for he says, "on architectural subjects, or that which has to do with the subtleties of the art, and the questions and disputes concerning them, I neither could nor would have anything to say." So that the science has received no direct advantage from the labours of Schneider, and yet how much was to be done might be understood by ten discoveries in confirmation of the theories of Vitruvius, made within a few years, and chiefly by Englishmen, cited by the Professor in his previous course on the literature of the art. Such discoveries suggested the desirableness of a new English edition of Vitruvius, as highly honourable and useful to this country. The last, by Mr. Gwilt, is a very useful one.

The slanders of Schneider had been adopted in this country with little honour to the parties, and no advantage to architecture. Vitruvius remained the father of our art, and was entitled to our respect, as the text-book of our studies.

Having been appointed surveyor to the warlike engines and stores of the empire by Augustus, Vitruvius was endowed with leisure; and very probably was instructed to collate the Greek authors on our art, whom he enumerates, and who were collected and deposited in the magnificent library instituted at that period. He appears then with singular advantage as transmitting the well digested and received principles of the greatest masters who had thought and written on architecture, to modern times; and the principles thus derived directly from the Greeks merit our closest attention.

But a few preliminary observations on external forms, in detail and in general, were to be made. The universality of certain primordial forms in all styles, favours the notion of innate ideas, the cube, the sphere, the ellypsoid in solids; the lozenge, the wave, cymarecta, and cymareversa, the serpentine, the ovalo, the spiral, the volute, gradation or diminution of forms, are common to the art of all times and people.

The pyramid is universal, from the compressed to the acute. Such is the charm of the pediment, that "in heaven, where we may not suppose it to rain," says Cicero, "the pediment will surely be found;" so in mountains, trees, and fixed bodies, in which the laws of statics are observed, the pyramid prevails; except in those forms in which dynamics demand a different structure. The pyramidal inclination of the sides of buildings observed in Egyptian, Hindoo, Gothic, and Mexican architecture, has, by the happy discoveries of late years, been proved to exist in Greece also; and the inclination of the axis of the columns at the sides of temples (enjoined by Vitruvius, lib. iii. c. 3, long disputed,) is now beyond all doubt, and the pyramidal inclination to building is proved to be an universal principle.

Gradation of columnar forms, as in the limbs of animals, and in vegetable productions, is universally approved; the cylinder, the leg of an elephant, are justly repudiated: "small by degrees, and beautifully less," has been denied by an eminent critic (P. Knight), "because," says he, "the same is large by degrees, and beautifully bigger;" but however smart the reply, it does not controvert the principle. It is, however, to be observed, that such forms should diminish *from the eye*, as a column does above the horizon, and the leg of a chair or table below it.

The Doric cymatium, the cymareversa, the ovalo, the cavetto, or hollow, are all calculated to express strength, as robust, and appearing to sustain. The Lesbian cymatium, the cymarecta, in all its varieties, has not the same purpose, (namely, to sustain,) and is suited to the more elegant orders. The principle of the application of mouldings for beauty, is the opposition of the curved to the straight surfaces, as well for light and shade as form; and for proportions and oppositions of such forms, constitute the art of profile—a most difficult grace of architecture; for by this, that variety of form and grace may be given which the primary architectural masses and proportions do not admit of. Variety in the *details of sculpture and profile is essential* to the relief of that rigorous geometrical order, which the larger features of architectural composition impose: in all the arts, and even in architecture, variety is an all-important principle, provided the masses are undisturbed. Shakspeare describes Cleopatra as chiefly admirable for this quality:

> Age cannot wither her, nor custom stale
> Her infinite variety.

The Greek profile is general (more particularly in the Parthenon) is incalculably superior to any other in gradation, quantity, delicacy, and expression, and should be the student's constant study. It was the observation of the human, animal, and vegetable forms, by the sculptors of Greece, which gave them that acknowledged superiority. The enrichment of these with homogeneous ornament, was no less remarkable, and deserves an especial treatise. In fact, the elements of architecture, in the orders and their profile, constitute the peculiar excellence of Greek architecture, which, as we have seen in history, did not extend to the composite and voluminous combinations which subsequent ages adopted.

Having thus adverted to individual forms as applied to detail, the Professor remarked upon general forms, as applied to the composition of buildings. The observations already offered upon the ancient system of building "in large stones and costly stones, even great stones," doubtless contributed much to the universal adoption of horizontal forms of building. But this tendency, thus imposed by the mechanical construction, seems also to have been an abstract principle of taste, which was consulted best by the contrast of the long horizontal form, with the (generally) vertical outline of the country in which they were employed. When the traveller, passing through a mountainous region of rugged outline, discovers through some gap the horizon of an extended plain, or of the ocean, a sublime sensation is experienced. In such a country the rocks and mountains afford elevations compared with which the works of man are insignificant. The temple is planted on the precipitous eminence, and it attains at once the elevation of St. Peter's or St. Paul's. So placed, the Doric members should be massive, simple, and few; the parts broad; it seems to have grown spontaneously from its rocky bed, and to partake in its monolithic masses of the stony aboriginal material on which it is established. Its horizontal outline and regularity of order are admirably calculated to contrast with the surrounding scenery of vertical and irregular forms.

On the other hand, when the road winds through interminable plains, the traveller recognizes the sublime in the contrast of vertical forms of architecture; for this reason, it may be presumed, the Babylonians in the plains of Assyria, proposed to "build a city and a *tower* whose top may reach unto the heavens." In the flats of Venice, in the Netherlands, in the champains of France and England, especially in the low lands of Lincolnshire and the North, the spire and the tower are found to be the effective and all-sufficient means of obtaining that sublime which man desires in architecture—that conglomerate composition of small stones which a man may carry up a ladder on his back, are in character with the style and the manner of building.

But, recurring to the theory of the art, we find that Vitruvius (lib. i. c. 11.) lays down six principles: order, as addressing the understanding; disposition, as addressing the eye; proportion; symmetry; consistency; and distribution, or economy.

Order, as evincing design, whether geometrical or moral, affects the mind with the sentiment of sublime. Whoever considers the movements of the planets, and understands the laws of their velocities, the curves which they describe, the relations of the periods of their revolutions and their distances, will find himself wrapt in a sublime pleasure, and will recognize a divine beauty of order; but if he turns his contemplation to the fixed stars, in which he can trace no order, and which appear to be disposed fortuitously, the same pleasure is by no means felt.

When a curve is formed by a certain rule and a constant law, as the semicircular vault and the apsis at the end of a church, both which shall be concentric, a great satisfaction is experienced; if these are elliptical, the rule and law is less easily understood; but much more, if eccentric segments are employed, the want of that uniformity is felt, and a kind of violence is done to the eye and understanding. So the rhomboid, and much more the trapezium, displease by their anomalous and unequal angles. No predetermined counsel, order, or industry are evinced, and the essential sense of order is dissatisfied,

If the philosopher finds any natural production—a stone, or a root—assuming the regularity of a geometrical form, he judges it worthy of a place in his museum: such is the love of order. Individuals in a mob have neither force nor effect, but ranged in regimental order they acquire a new quality. So trees planted in avenue have, in many situations, an effect superior to the forest. The desire of imparting variety to his work, often misleads the architect from this important principle of his art; forgetting that his building is to derive its chief effect from the contrast of its regularity and order with the surrounding irregular objects and scenery, he seeks, too often, to make his own building his picture, and to engraft upon it that variety which the scenery ought to supply. Thence picturesque architecture, which has diverted the student from the ancient principles, universal amongst the old masters. Succession and repetition of impression by parity of objects, by regularity and order, the isometrical colonnade or Gothic arches of the nave, or equidistant windows along an unbroken front, have more energy and effect than all the varieties of such features that can be contrived. The surrounding irregularities make order tell by their contrast.

Vanbrugh was remarkable for this quality, and he knew at the same time how, by the composition of his parts, to produce, from certain points of view, the utmost variety of combination and picturesqueness, while, from others, the whole was perfectly regular.

Perrault observed order rigidly, as did Wren; while by the contemporary fashionable architects amongst the Italians it was totally abandoned, as may be remarked in the front of St. Peter's, and in the works of Bernini, Borromini, and Maderno. Columns in groups, or at irregular distances, broken entablatures, for the sake of a repetition of profiles, curvilinear fronts, and such scenery as belongs to painting, established the novelty of picturesque architecture—a solecism in art, and a contradiction in terms, unless by combinations from certain points of view as above.

If we call to mind the fact, that the greatest architectural efforts have usually followed periods of political and moral disorder, we may recognize in such works that natural love of order, which revolutions and tumults have denied. Certain it is, that after a long period of civil tranquility, architectural efforts, especially of regular order, have ceased to be fashionable, and the picturesque or the irregular is resorted to as a change.

Disposition or composition of the various features of an architectural work, is the second principle laid down by Vitruvius. It consists, says he, of the idea of the ichnography; the idea of the orthography, or elevation; and the idea of the scenography, or view in perspective, taken on the angle. "These," continues he, "are the result of thought and invention; thought, full of attention, application, and vigilance, accompanied with *delight;* and invention, which is a solution of different problems by new applications seized with *promptitude.*"

Thus he proceeds as nature does: putting the purpose or the plan *first*, to which the figure of the object adapts itself *secondly*, and thus each composition displays peculiar features; and the appearance of his buildings would be as various as their purposes; whereas modern architects often reverse the method, and they constrain the plan to a preconceived orthography. How otherwise is it that we recognize the master the moment we see his work? The orthography ever the same, and the plan adapting itself as it can: so we commonly put the cart before the horse.

But the exact conception of the ultimate effect of the building, the realization of the prophetic vision of the architect, are of extreme difficulty, and subject to lamentable disappointment. They can be attained only by great knowledge of perspective, and by careful models; and the greatest masters have been most remarkable for their reliance on such means.

"The architect," says Wren, "ought, above all things, to be well skilled in perspective, for everything that appears well in orthography may not be good in the model, especially when there are many angles and projectures; and everything that is good in model may not be so when built, because a model is seen from other stations and distances than the eye sees the building. But this will hold universally true, that whatsoever is good in perspective, and will hold so in all the principal views, whether direct or oblique, will be as good in great; if this only caution be observed, that regard be had to *the distance of the eye in the principal stations.*"

In this last particular the methods of the different masters have varied materially. For instance, Vanbrugh always supposed himself at a distance of 500 to 1000 feet from his buildings; consequently his sky line and contour are well studied, but his details wholly neglected, and the pleasing effect of his buildings in approaching them; whereas Adams supposed himself from 50 to 100 feet only from his buildings; consequently they have no contour from a distance, but are full of elaborate detail on the approach.

The visual angle, extending at most to 45°, should be carefully applied to the points of distance; and the scale of the drawing or study should be correctly adjusted to this distance, so that no misconception should arise. A study for a building to be seen at 100 feet distance only, will be on a large scale, and occupy the whole height of the paper; whereas, seen at 500 feet, it may be only one-fourth that size.

The Greeks were consummate masters of this branch of optics, as we should doubtless have known had Aristotle's work on taste been preserved to us. The terms synoptic and eusynoptic correspond with the points of view which all their arrangements were calculated to afford.

The Parthenon and the Temple of Jupiter Olympius—indeed, almost all the great temples—were approached on the angle, the peribolus and the propylea by which they were inclosed, concealing great part of them, until they could be contemplated to the utmost advantage from a synoptical point of view. The plans of Palmyra and Balbec, and those of Rome, preserved to us by Palladio, are lessons, in these respects, demanding the most careful attention.

It is obvious that street architecture, being seen chiefly in flank, should be treated otherwise than buildings at right angles with the point of view, as triumphal arches, or terminations to the vista.

In the 15th and 16th centuries perspective delineation became a new art in the hands of Lombardi, Bramante, Peruzzi. Raphael, and lastly the renowned Pozzi; and though Vitruvius assures us that in the 5th century B.C. Agatharcus wrote a treatise upon perspective, it is probable that the ancients never arrived at the skill attained by those masters.

But perspective calculation applied to architecture, and the adjustment to the point of view, was undoubtedly better understood practically by the ancients than ourselves, as their remains abundantly prove. The vista which shortens the length and discloses the end at once—the exposure of the entire object staring from a distance as well as near—the placing colossal objects in colossal places, are all modern mistakes. The temple at Luxor, the colonnade at Palmyra, are deflected in angles, so that the bounds are concealed, the successive columns disclose themselves by degrees, and the length seems interminable. The temple is partially hidden, and excites the imagination from the promise of its roof, entablature, and capitals, until it is permitted to be seen in its overwhelming majesty.

The columns of Trajan and Antonine are placed in confined positions, and the effect is tenfold.

Palladio was remarkable for the adjustment of his building to the position, of which the Town Hall at Vicenza is one of the most remarkable examples; and the surprise and admiration of the traveller who has known that building only in the orthographic engravings can never be forgotten.

Vignola is said to have made his studies of his buildings at the points of view from which only they could be seen.

It is quite certain that Sir W. Chambers was less master of this part of his art than of many others. Any one visiting the front of Somerset House, in the Strand, is satisfied with its scale and sufficiency in all respects; but when he enters the spacious quadrangle, and looks on the back of the same building, he experiences some disappointment; he finds the scale too small for the size of the quadrangle; but much more, when he observes the same proportions from the opposite side of the river, he deplores their littleness and want of mass and feature, the petty dome in the centre, and the confusion of chimney shafts which disfigure the roof. Had Vanbrugh disposed the river front, we should have seen those chimney shafts united in towers; the whole outline or sky-line would have been marked and varied with emphatic features, suited to the scale of the river and the majestic position given to the building.

"It is the part of a wise man," says Alberti, "to have the idea of his work well fixed in his imagination. The ancients, therefore, not only by perspectives, but by models of the whole, and of parts, submitted their works to practised men before they laid a stone. Such models should not, however, be pretty toys, in which delicacy of workmanship draws the attention from the merit of the design. Finally," continues Alberti, "when the model satisfies the architects and practised judges, I recommend that there should be no hurry to begin, but if possible time should be allowed that the conceit of the design may cool; when, having laid aside the natural overweening affection for your own production, you may judge more justly of its effect. Time discloses many counsels for the advantage of our undertakings; and many defects, which at first escaped attention, at length become apparent." Scamozzi used to say, that pretty little models were like pretty little birds, no one could tell whether they were masculine or feminine; but if made large, you might then discern which was an eagle and which a crow.

Vitruvius, lib. vi. c. 11, and lib. iii. c. 111, refers to optical effects.

Proportion is the third principle set forth by Vitruvius, the most difficult and the most precious to the architect, and no less a golden rule in his art than in that of the arithmetician. Symmetry, which is the fourth principle of our author, is, by a vulgarism, often mistaken for proportion; but the etymology defines its meaning, as correspondence or parity of parts on either side a centre; at most it may signify proportion of aliquot parts. No part of architecture has occupied the speculations of the ingenious more than proportion, and those who have not found the analogy of the human form, as set forth by Vitruvius from the Greeks, sufficient, have endeavoured to find a more certain analogy in the laws of musical sounds: Blondel, Ouvrard and others, may be consulted on this point.

To the artist observer of the proportions and forms of animal nature, the Greek analogy seems to develop the science of proportion in the comparison of animals of the same genus, but of various species, sufficiently to show that beauty resides in inequalities; the measure of those inequalities is, indeed, not so easily defined; but the establishment of the fact may help the architect to some valuable conclusions.

Thus, if we divide the human profile, the forehead, the nose, the upper lip, and the chin, into equal parts, we have ugliness: the profile of the Apollo presents these parts in *inequalities*, and upon the nice variety of these beauty depends.

The satyrus, or baboon, is ugly, compared with the man: amongst many other reasons, for this, especially to the architect, that his proportions approach equalities. The baboon is six heads high; his arms equal the entire length of his body and legs; the subdivisions of the arm, the hand, the fore-arm, and os humeri, are nearly equal; so also the foot, the leg, and the thigh. If these proportions are compared with the human form divine, in which they are all in different and unequal lengths, the cause of beauty will be at once apparent. The human figure is eight heads high, and is inscribed by Vitruvius in a square, whereas the baboon is inscribed in a figure of less beauty, namely, a parallelogram of six by eleven, such is the length of his arms. Thus, again, if we inquire why the ass is so inferior to the horse, we shall find the same answers. The one is little more than two heads to the shoulder, while the horse is 2½; the ears of the ass approach equality with the head or neck. The scapula to the os humeri, in the ass, four to five, in the horse is four to six; the metacarpus to the radius three to five in the ass, is 2½ to five in the horse.

The Professor exhibited drawings in illustration of these remarks, and stated, that the same relations applied to vegetable nature, and that beauty there, also, would be found to reside in inequalities; and he proceeded to show, that orthographic equalities in the vertical features of architecture, both in the divisions of floors and orders, and in details, were always evidences of the decline of taste. In Greek profile it would be found universally, that the inequalities constituted their charm; in the Roman they were not so nicely observed; in the Byzantine, the plain and moulded surfaces approached equalities. So in Gothic architecture, the period of the thirteenth was far superior to any other in this respect; of which the transept of Beverley Minster, and the order of Salisbury Cathedral were beautiful illustrations. So in every other architecture, and informs of all kinds. In fact, from the long and the short, the dactyle and spondee, hexameter and pentameter, sapphics and iambics, the very term ευρυθμια (proportion), used by the Greeks, was derived.

Under the fifth head, Consistency, lib. i. c. 2, Vitruvius tells us, that circumstance, custom, or fitness, and nature are to guide us. Temples to Jupiter Cœlus, the sun and moon, are to be hypethral, because these divinities are known to us by their continual presence night and day. Doric temples are to be erected to Minerva, Mars, and Hercules, on account of their masculine character; Corinthian is proper to Venus, Flora, Proserpine, &c.; Ionic, as the medium order, is applicable to Juno, Diana, and Bacchus; all these, says he, bear an *analogy* to the dispositions of the deities.

Again, in lib. iii. c. 1, he says, "the design of temples depends on symmetry, the rules of which architects should be most careful to observe; symmetry arises from proportion, which the Greeks call αναλογια." He then proceeds to describe the proportions of the human figure in detail, and remarks its correspondence with the geometrical figures, the square and the circle; even the measures used in buildings, the digit, the palm, the foot, the cubit, called by the Greeks τελειος, prove the analogy of architecture (continues he) with the human proportions.

In lib. iv. c. 1, Vitruvius describes the origin of the Doric, Ionic, and Corinthian orders, as derived from the proportions of the man, the matron, and the damsel, by analogy; and although these analogies have been regarded by some as fanciful, their æsthetical propriety is more intelligible to the artist, than their definition by language to the logical reader. For instance, the ancient Doric, from five to six diameters in height, though low in its proportions, assumes a dignity in its concentrated strength and solidity, its rapid diminution, and its wide-spreading cap, which no one who has viewed it at Pœstum and at Corinth can ever forget.

When Homer describes Priam as identifying the Grecian leaders from the walls of Troy, he is made to inquire of Helen—

> What's he whose arms lie scattered on the plain;
> *Broad in his breast, his shoulders larger spread,*
> Though great Atrides overtops his head?

Had Homer (always a painter) confined his description to the stoutness and the shortness of Ulysses, we should have been at a loss for his heroic dignity; he might have been a tub or an alderman, but the "broad shoulders and spreading breast" imply the rapid diminution of the waist, and the same healthful and vigorous character through every limb; and Ulysses stands before us in all the energy of the Grecian hero—

> Though some of larger stature tread the green,
> *None match his grandeur and exalted mien!*

no such peculiarity is attributed to "the great Atrides;" the tall is not compatible with this rapid diminution: whenever these qualities, therefore, are affected, as in the Parthenon, the temple of Nemea, or in the Roman Doric, the upper diameter bears a larger proportion to the lower. So in the matronal or the medium proportion, the gradation of form is much smaller; and in the juvenile Apollo or the young damsel, the diminution of the limbs is still less observable; and the Ionic or the Corinthian are proportioned accordingly. In the details the same analogy is observed; the mouth, the eye, and the features of the Hercules are as susceptible of delicacy as the Doric echinus is of its small fillets and its fine contour.

The matronal or medium demands a sober ornament, and the Corinthian all the young elegance which the acanthus and the graceful Lesbian profile can communicate.

Thus the tall, the short, and the slender, are all types of proportion in their proper places; their *excess* makes them the awkward and ungainly, the clumsy and shapeless, and the thin or meagre; and there is no other course by which they can be rightly embodied, than by the careful and intelligent observation of those types, as exhibited in the works of nature—in the animal and vegetable kingdoms.

In this respect taste, like wit, consists in discovering resemblances and unexpected congruities.

The history of the works of genius illustrates abundantly the reference to analogy in the science as well as in the art of architecture. Smeaton, in his work on the Light-House at Eddystone, after describing the former ones, and showing their defects, proceeds to explain his original conception of that celebrated work. "On this occasion," says Smeaton, "the natural figure of the waist or bole of a large spreading oak presented itself to my imagination. Its top, when full of leaves, is subject to a very great impulse from the agitation of violent winds; yet partly by its elasticity, and partly by the natural strength arising from its figure, it resists them all, even for ages. It is rare that we hear of such a tree being torn up by the roots. Let us now consider its particular figure. Connected with its roots, which lie hid below ground, it rises from the surface thereof with a large swelling base, which at the height of one diameter is generally reduced by an elegant curve, concave to the eye, to a diameter less by at least one-third, and sometimes to half, of its original base. From thence its taper diminishing more slow, its sides by degrees come into a perpendicular, and for some height form a cylinder. Now, we can hardly doubt but that every section of the tree is nearly of an equal strength in proportion to what it has to resist; and were we to lop off its principal boughs, and expose it in that state to a rapid current of water, we should find it as much capable of resisting the action of the heavier fluid, when divested of the greatest part of its clothing, as it was that of the lighter when all its spreading ornaments were exposed to the fury of the wind. And hence we may derive an idea of what the proper shape of a column of the greatest stability ought to be, to resist the action of external violence, where the quantity of matter is given whereof it is to be composed."

Sir C. Wren has given another fine example of this kind of analogy. In the vast practice which the fifty churches of this metropolis and the examination of all the authorities which he had occasion to consult had given him, he reflected that the hollow spire which he had seen or built in so many varieties was after all but an infirm structure; and he sought that model which should enable him to impart to it the utmost solidity and duration. Simple was the original from which he adopted his idea. He found that the delicate shell called turretella, though extremely long, and liable to fracture from its base to its apex, by the action of the water amidst the rocks, was rendered impregnable by the central column, or newel, round which the spiral turned. Therefore, in his spire of St. Bride's, he establishes the columella in the centre, round which he forms a spiral staircase to the top, issuing on stages of arched apertures: thus giving us (if not the most beautiful) certainly the most remarkable and enduring of any spire hitherto erected.

One more instance equally remarkable may be given. When Brunelleschi was charged with the erection of the dome of Sta. Maria, at Florence, of nearly equal diameter with that of the Pantheon, but at more than twice its height from the pavement, upon a base raised on piers, and by no means of the strength and cohesion of the original model, the Pantheon, it was apparent that in giving it the same solidity, the weight would be insupportable on such a foundation. How was this object to be accomplished? Brunelleschi was an observer of all nature's productions, and he reflected that the bones of animals, especially of birds, possessed solidity without weight, by the double crust and hollow within. But above all, he remarked that the dome which completes the architecture of the human form divine was constructed with a double plate, connected by the light and fibrous, but firm walls of the hollow cancelli, so that strength and lightness were combined in the utmost degree. Brunelleschi followed this model in his dome of Sta.

Maria (in the manner displayed in a large section exhibited); and the traveller now ascends to the lantern between the two crusts or plates forming the inner and the outer domes.

Michael Angelo adopted this contrivance in the dome of St. Peter's; and almost all the subsequent domes are upon the same idea.

The Professor pointed out these instances of analogy as sufficient to show that the architect might thus avail himself of the whole range of Nature's works; and that the universe furnished him the inexhaustible models from which his inventions might be drawn.

REVIEWS.

THE ANCIENT RUINS OF YUCATAN.

Rambles in Yucatan. By B. M. NORMAN. New York: 1843.

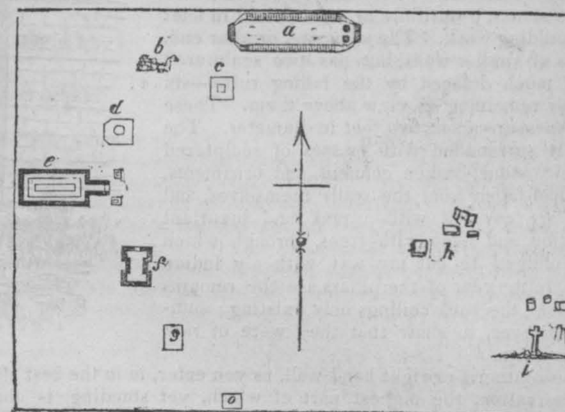
The last quarter of a century has been distinguished by the scientific and successful researches which have been made into the material and moral world of unrecorded ages. What the far-seeing predicted, but hardly hoped would occur, what the visionary exhausted himself in vain efforts to ascertain, has now taken place; the film, the mist which concealed and disfigured the unknown past, is giving way before the labours of men of science, and the long-hidden forms of antiquity's infancy are becoming revealed to our eyes: while the progress made is such that we can scarcely doubt of a glorious harvest of discovery in the end. While geology and palæozoology have shown us the rudiments of the physical world, portrayed its vegetation, and pictured the creatures which inhabited it, philology and paleætiology have thrown glorious light upon the early history of the human race. While geology was pursued on a false system, and theories were formed before facts were accumulated, its votaries were the derision of the world; nor did the philologists suffer less deservedly: their wild speculations drew from Voltaire the definition that their science was one in which "*la consonne y entrait pour fort peu de chose et la voyelle pour rien*:" and Goldsmith sarcastically determines from the resemblance of the letters, that CON-FU-CI-US and NOAH were the same personages. This time, however, has now passed, and both geology and philology, studied upon the principles of Bacon, have become fixed sciences. From philology has sprung paleætiology, or the science of applying philological evidence to the history of the human races, and Bopp, Pott, Raske, Prichard, Winning, and others have successfully laboured in this department. In connection with these studies is that of the early monuments of art, the elucidations of which in Egypt, in Iranistan, in India, and America, deeply engage the attention of men of science. If in the old world we are astonished at the gigantic records of ancient civilization, we were totally unprepared to find the new continent as rich in these memorials as our own. Records of a race which seems to have "died and left no sign," works without a name, monuments bearing the impress of the fathers of civilization in India and Egypt—they are calculated to awaken the deepest interest, and to enlist the strongest sympathy of the artist and the scholar. Humboldt and Lord Kingsborough prepared the way in the study of Mexican antiquities, which Waldeck, Stephens, and Norman have followed out: and the result is, the opening a field of study in Yucatan, rich in architectural and artistical interest.

For a copy of Mr. Norman's work, we have been indebted to the kindness of Messrs. Wiley and Putnam, and we proceed to give some account of it and its author. Mr. Norman was led to Yucatan in a chance excursion in the autumn of 1841, and commenced his researches with no other instrumental aid than a knife and pocket compass, and pencil and paper; yet, although he pretends to no scholarship, he has produced a work, containing minute descriptions of the ruins, with many notes derived from the works of his predecessors. He seems to have been an active and energetic observer, and to have gone about his task with all that poco-curantism for trifles, which the wanderer in Spanish countries must possess if he would make himself happy and useful. Mr. Norman's journal contains descriptions of the manners and customs of the people, as well as accounts of the ruins, which were the more especial objects of his visit.

Yucatan, we need scarcely remind our readers, is a peninsula, remarkable for running from south to north, bounded on the east by the English settlement of Honduras, on the south by Guatimala, and on the south-west by Mexico, of which it was recently a province, although now independent. The west coast is known to us as the Campeachy shore, and was the scene of many an exploit in the logwood-cutting times of the early part of the seventeenth century. The country itself presents but little to interest us in its modern state, but in the northern parts have been discovered the ruined cities of Uxmal, Kabah, Zayi, Ticul, Sisal, Chi-Chen, and Espita; and it will be observed that not more than a third of the country has been as yet imperfectly explored, while what the mountain regions of the interior may present is unknown. The inhabitants are chiefly of Indian descent, called Mayas, of whom we shall speak again hereafter.

Leaving Mr. Norman to speak for himself, the first place to which he leads us is Chi-chen, of which a plan is shown below.

Fig. 1.—Plan of the Ruins of Chi-Chen.



a, temple; *b*, ruins; *c*, pyramid; *d*, dome; *e*, house of the Caciques; *f*, house; *g*, hacienda; *h*, evidences of large and splendid structures; *i*, cross erected by the Indians; *o*, church of the Indians.

"It was on the morning of the 10th of February that I directed my steps, for the first time, toward the ruins of the ancient city of Chi-Chen.[1] On arriving in the immediate neighbourhood, I was compelled to cut my way through an almost impermeable thicket of under-brush. interlaced and bound together with strong tendrils and vines; in which labour I was assisted by my diligent aid and companion, José, I was finally enabled to effect a passage; and, in the course of a few hours, found myself in the presence of the ruins which I sought. For five days did I wander up and down among these crumbling monuments of a city which, I hazard little in saying, must have been one of the largest the world has ever seen. I beheld before me, for a circuit of many miles in diameter, the walls of palaces and temples and pyramids, more or less dilapidated. The earth was strewed, as far as the eye could distinguish, with columns, some broken and some nearly perfect, which seemed to have been planted there by the genius of desolation which presided over this awful solitude. Amid these solemn memorials of departed generations, who have died and left no marks but these, there were no indications of animated existence save from the bats, the lizards, and the reptiles which now and then emerged from the crevices of the tottering walls and crumbling stones that were strewed upon the ground at their base. No marks of human footsteps, no signs of previous visitors, were discernible; nor is there good reason to believe that any person, whose testimony of the fact has been given to the world, had ever before broken the silence which reigns over these sacred tombs of a departed civilization. As I looked about me and indulged in these reflections, I felt awed into perfect silence. To speak then, had been profane. A revelation from heaven could not have impressed me more profoundly with the solemnity of its communication, than I was now impressed on finding myself the first, probably, of the present generation of civilized men walking the streets of this once mighty city, and amid

'Those temples, palaces, and piles stupendous,
Of which the very ruins are tremendous.'

For a long time I was so distracted with the multitude of objects which crowded upon my mind, that I could take no note of them in detail. It was not until some hours had elapsed, that my curiosity was sufficiently under control to enable me to examine them with any minuteness."

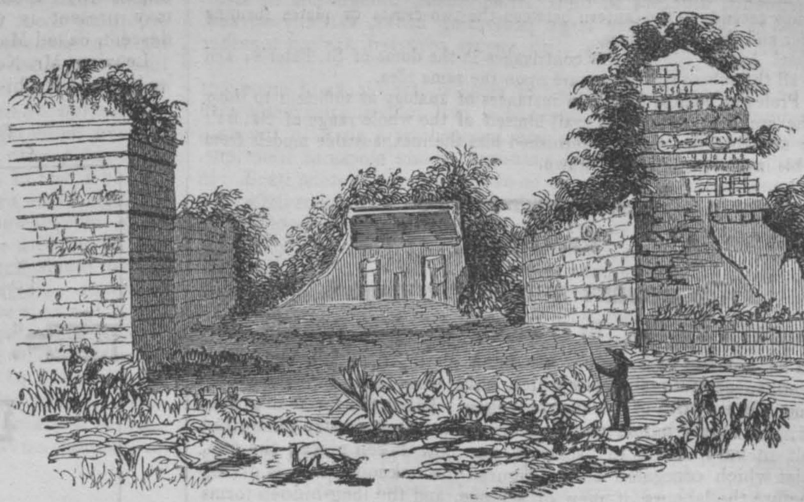
"My first study was made at the ruins of the TEMPLE.[2] These remains consist, as will be seen by reference to the engraving (*a*, Fig. 3, & Fig. 4), of four distinct walls. I entered at an opening in the western angle, which I conceived to be the main entrance; and presumed, from

"[1] Chi-Chen signifies, mouth of a well. 'Itza,' said to be the Maya name for one of the old possessors of these ruins, is sometimes added by the natives.

"[2] The names by which I have designated these ruins, are such as were suggested to me by their peculiar construction, and the purposes for which I supposed them to have been designed.

the broken walls, ceilings, and pillars still standing, that the opposite end had been the location of the shrine or altar. The distance between these two extremes is 450 feet. The walls stand upon an elevated foundation of about 16 feet. Of the entrance, or western end, about one-half remains; the interior showing broken rooms, and ceilings not entirely defaced. The exterior is composed of large stones, beautifully hewn, and laid in fillet and moulding work. The opposite, or altar end, consists of similar walls, but has two sculptured pillars, much defaced by the falling ruins—six feet only remaining in view above them. These pillars measure about two feet in diameter. The walls are surrounded with masses of sculptured and hewn stone, broken columns, and ornaments, which had fallen from the walls themselves, and which are covered with a rank and luxuriant vegetation, and even with trees, through which I was obliged to cut my way with my Indian knife. In the rear of the pillars are the remains of a room, the back ceilings only existing; sufficient, however, to show that they were of rare workmanship.

Fig. 2.—The Temple—Chi-chen Ruins.



"The southern, or right hand wall, as you enter, is in the best state of preservation, the highest part of which, yet standing, is about 50 feet; where, also, the remains of rooms are still to be seen. The other parts, on either side, are about 26 feet high, 250 long, and 16 thick, and about 130 apart. The interior, or inner surface of these walls, is quite perfect, finely finished with smooth stone, cut uniformly in squares of about two feet. About the centre of these walls, on both sides, near the top, are placed stone rings, carved from an immense block, and inserted in the wall by a long shaft, and projecting from it about four feet. They measure about four feet in diameter, and two in thickness—the sides beautifully carved.

"The extreme ends of the side walls are about equi-distant from those of the shrine and entrance. The space intervening is filled up with stones and rubbish of walls, showing a connexion in the form of a curve. In the space formed by these walls are piles of stones, evidently being a part of them; but there were not enough of them, however, to carry out the supposition that this vast temple had ever been enclosed. At the outer base of the southern wall are the remains of a room; one side of which, with the angular ceiling, is quite perfect, measuring 14 feet long and 6 wide. The parts remaining are finished with sculptured blocks of stone of about one foot square, representing Indian figures with feather head-dresses, armed with bows and arrows, their noses ornamented with rings; carrying in one hand bows and arrows, and in the other a musical instrument similar to those that are now used by the Indians of the country. These figures were interspersed with animals resembling the crocodile. Near this room I found a square pillar, only five feet of which remained above the ruins. It was carved on all sides with Indian figures, as large as life, and apparently in warlike attitudes. Fragments of a similar kind were scattered about in the vicinity.

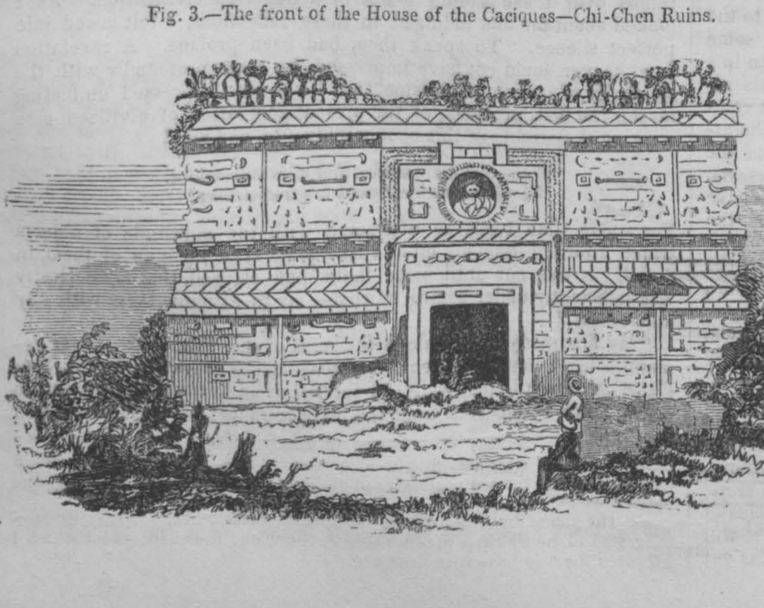
"From this room, or base, I passed round, and ascended over vast piles of the crumbling ruins, pulling myself up by the branches of trees, with which they are covered, to the top of the wall: where I found a door-way, filled up with stones and rubbish, which I removed, and, after much labour, effected an entrance into a room measuring 8 by 24 feet, the ceiling of which was of the acute-angled arch, and perfected by layers of flat stones. The walls were finely finished with square blocks of stone, which had been richly ornamented. Even yet the heads of Indians, with shields and lances, could be distinguished in the colouring.

"The square pillars of the door-way are carved with Indians, flowers, borders, and spear-heads; all of which I judged to have once been coloured. The lintel, which supported the top, is of the zuporte wood, beautifully carved, and in good preservation. One of the Indian head-dresses was composed of a cap and flowers.

"Immediately in front of the door-way is a portion of a column, to which neither cap nor base was attached. It measured about three feet in diameter, with its whole surface sculptured; but it was so obliterated by time, that the lines could not be traced. Four feet of its length only could be discovered. It was, evidently, imbedded in the ruins to a great depth. Numerous blocks of square hewn stones, and others, variously and beautifully carved, were lying in confusion near this column.

"Of the exterior of these walls, a sufficient portion still exists to show the fine and elaborate workmanship of the cornices and entablatures, though the latter are much broken and defaced. They are composed of immense blocks of stone, laid with the greatest regularity and precision, the façades of which are interspersed with flowers, borders, and animals."

Fig. 3.—The front of the House of the Caciques—Chi-Chen Ruins.



"I cut my way through the thick growth of small wood to the House of the Caciques, and by the aid of my compass was enabled to reach the east front of the building. Here I felled the trees that hid it, and the whole front was opened to my view, presenting the most strange and incomprehensible pile of architecture that my eyes ever beheld—elaborate, elegant, stupendous, yet belonging to no order now known to us. The front of this wonderful edifice measures 32 feet, and its height 20, extending to the main building 50 feet. Over the door-way, which favors the Egyptian style of architecture, is a heavy lintel of stone, containing two double rows of hieroglyphics, with a sculptured ornament intervening. Above these are the remains of hooks carved in stone, with raised lines of drapery running through them; which, apparently, have been broken off by the falling of the heavy finishing from the top of the building; over which, surrounded by a variety of chaste and beautifully executed borders, encircled within a wreath, is a female figure in a sitting posture, in basso-relievo, having a head-dress of feathers, cords, and tassels, and the neck ornamented. The angles of this building are tastefully curved. The ornaments continue around the sides, which are divided into two compartments, different in their arrangement, though not in style. Attached to the angles are large projecting hooks, skilfully worked, and perfect rosettes and stars, with spears reversed, are put together with the utmost precision.

"The ornaments are composed of small square blocks of stone, cut to the depth of about one to one and a half inches, apparently with the most delicate instruments, and inserted by a shaft in the wall. The wall is made of large and uniformly square blocks of limestone, set in a mortar which appears to be as durable as the stone itself. In the ornamental borders of this building I could discover but little analogy with those known to me. The most striking were those of the cornice and entablature, *chevron* and the *cable* moulding, which are characteristic of the Norman architecture.

"The sides have three door-ways, each opening into small apartments, which are finished with smooth square blocks of stone; the floors of the same material, but have been covered with cement, which is now broken. The apartments are small, owing to the massive walls enclosing them, and the acute-angled arch, forming the ceiling. The working and laying of the stone are as perfect as they could have been under the directions of a modern architect."

Another description we take from him is that of the ruins of Zayi.

"The Ruins of Zayi are situated in the midst of a succession of beautiful hills, forming around them, on every side, an enchanting landscape.

"The principal one is composed of a single structure, an immense pile, facing the south, and standing upon a slight natural elevation. The first foundation is now so broken that its original form cannot be fully determined; but it probably was that of a parallelogram. Its front wall shows the remains of rooms and ceilings, with occasional pillars, which, no doubt, supported the corridors. The height of this wall is about 20 feet, and, as near as I was able to measure around its base, (owing to the accumulation of ruins,) it was ascertained to be 268 feet long, and 116 wide.

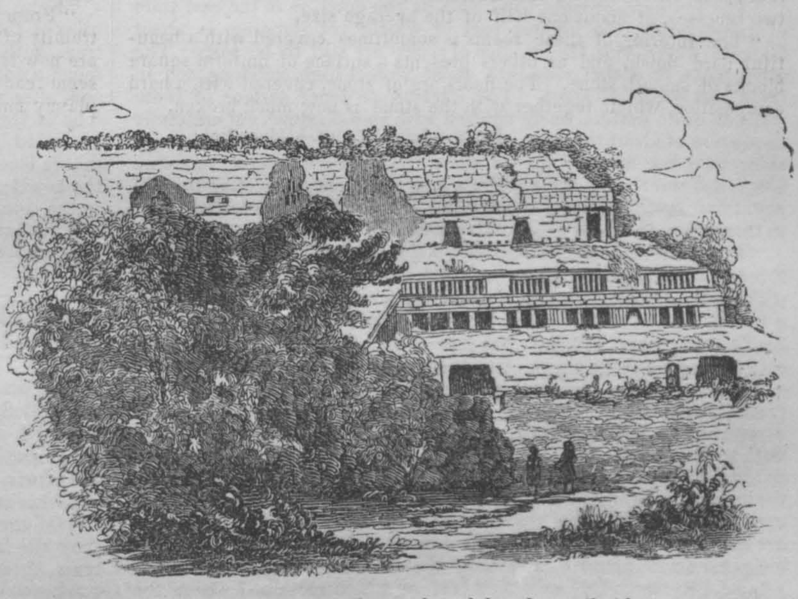
"In the centre of this foundation stands the main building, the western half only remaining, with a portion of the steps, outside, leading to the top. This part shows a succession of corridors, occupying the whole front, each supported by two pillars, with plain square caps and plinths, and intervening spaces, filled with rows of small ornamented pillars. In the rear of these corridors are rooms of small dimensions and angular ceilings, without any light except that which the front affords. Over these corridors, or pillars, is a fine moulding finish, its angle ornamented with a hook similar to those of Chi-Chen. Above this moulding is a finish of small plain round pillars, or standards, interspersed with squares of fine ornamental carvings; the centre of the façade showing the remains of more elaborate work, concentrated within a border, the arrangement of which is lost. There is an evident analogy existing between these ornaments and those of Kabbah, but order is less apparent. I could discover no resemblance whatever to those of Chi-Chen.

"Over these rooms of the main building is another terrace, or foundation, in the centre of which is a building in similar ruins to those under it; having, also, broken steps leading to the top. It stands upon a foundation, apparently, of six to eight feet in height, occupying about two-thirds of the area; the residue, probably, forming a promenade. There are three doorways yet remaining, the lintels and sides of which are broken, and which have caused the walls above to fall down. The walls of this part of the edifice are constructed of hewn stone, without any signs of ornament. A plain finished moulding runs through the centre; portions of the cornice still remain, with three or four pieces of flat projecting stones, which formed a part of the top finish.

"The whole extent of the rear is covered with confused piles of ruins, overgrown with trees. Near by these are fragments of walls and rooms, with a few ornaments yet remaining about them. Some of the rooms appear to have been single, and apart from all other buildings. There are also various mounds in the vicinity.

"A few rods south are the remains of a single high wall, with numerous square apertures, like pigeon-holes. Its foundation is elevated; around which the broken walls and ceilings are to be seen. The summits of the neighbouring hills are capped with gray broken walls for many miles around. I discovered no hieroglyphics or paintings of any kind; neither the extraordinary skill displayed in the ornamental carvings, as at Chi-Chen. On my route to these ruins I

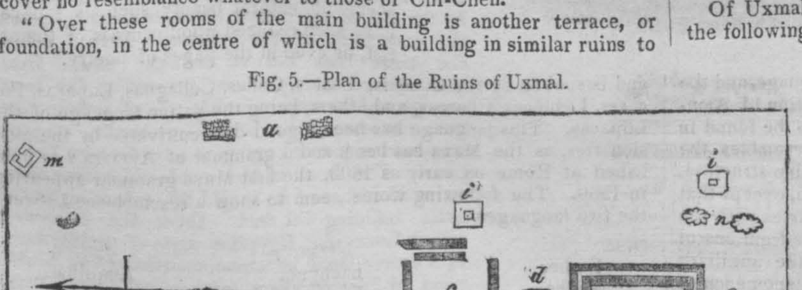
Fig. 4.—Zayi Ruins.



made digressions from the road, and found, on all sides, numerous remains of walls and ceilings; also, mounds and small pyramids, covered with the wild vegetation of the country."

Of Uxmal he gives a copious description, from which we extract the following.

Fig. 5.—Plan of the Ruins of Uxmal.



a a. Ruins; *b*, Governor's House; *c*, Nun's House; *d*, Snake; *e*, Ring; *f*, Pond; *g*, Reservoir; *h*, Pigeon House; *i i i*, Pyramids; *m*, Hacienda; *n*, Sepulchres; *o*, Mound.

"The Governor's House is a vast and splendid pile of ruins. It stands upon three ranges of terraces; the first of which is a slight projection, forming a finish. The great platform, or terrace above it, measures upwards of 500 feet long, and 415 broad. It is encompassed by a wall of fine hewn stone 30 feet high, with angles rounded, still in good preservation. In the centre of this platform, upon which trees and vegetation grow in profusion, stands a shaft of gray limestone in an inclined position, measuring twelve feet in circumference and eight in height; bearing upon its surface no marks of form or ornament by which it might be distinguished from a natural piece. Near by is a rude carving of a tiger with two heads; also, I saw excavations near them with level curbings and smoothly finished inside, which are conjectured to have been cisterns or granaries. Along the southern edge of this platform are the remains of a range of small pillars, now broken and in confusion.

"Upon the north-west corner of this platform is an edifice, which was, no doubt, from its location, connected with the Governor's House. It is the smallest of all the ruins. Its ornaments are few and plain; the most remarkable of which is a continuous line of turtles, cut from stone of about a foot square, arranged under the cornices.

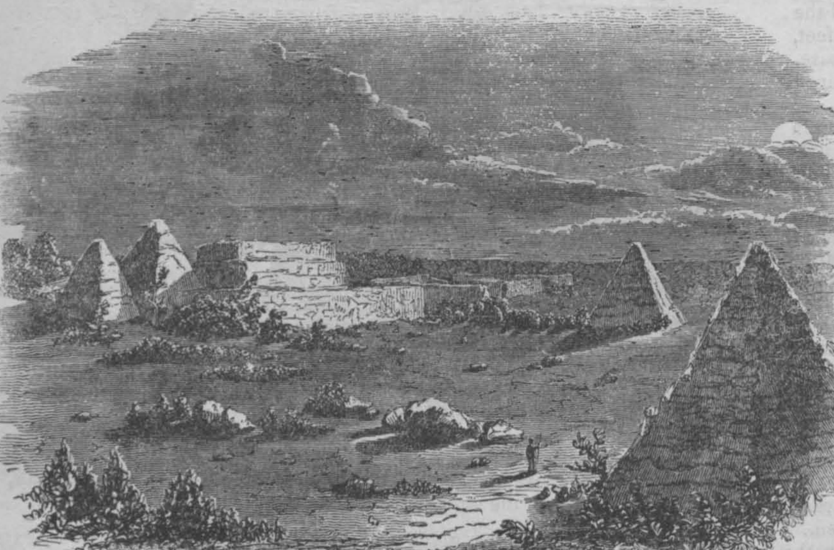
"The south-west corner has connected with it two piles of loose stones, in the pyramidical form; one 80, and the other 100 feet high, the sides of the bases measuring about 200 feet. Their tops are broad platforms, over which, and down the sides, are scattered the remains of edifices, of which these pyramids were once probably the foundations. Here we found pieces of pottery, consisting of broken pieces of vases, aud supposed cooking utensils.

"Upon the main terrace stands another of smaller dimensions, constituting the foundation of the Governor's House. The measurement of this terrace is 338 feet long, 82 broad, and 30 high, having a majestic flight of stone steps, though considerably broken at the centre, in front of the entrance.

"This majestic pile faces the east, is 272 feet long, 36 broad, and 24 high. The whole building is plain (unlike those of Chi-Chen) from the base to the mouldings, which run through the centre over the doorways; above which, to the top, are ornaments and sculptured work in great profusion, and of the most rich, strange, and elaborate workmanship. It is divided into double ranges of rooms, from front to rear. Two of the principal are situated in the centre, 54 feet long, 10 broad, and about 19 high, with an angular ceiling, occupying one-half of the whole. There are 14 other rooms in the front and rear; also, two rooms on each end, and one in front and rear of the two recesses, of about one-half of the average size.

"The interior of these rooms is sometimes covered with a beautiful hard finish, and at others presents a surface of uniform square blocks of smooth stone. The floors are of stone, covered with a hard composition, which, together with the stone is now much broken.

Fig. 6.—Uxmal Ruins.—(Moon light.)



"The lintels, which are of zuporte wood, are decayed and broken, to which, in a great degree, the falling of the walls may be attributed. The inner sides of the doorways are pierced, and hooks attached, whereon doors were probably swung. There are, also, apertures in the walls, where beams rested, to support hammocks, some of which still remain, and show the marks of the cords. There were no fresco, or other painting or decorations of any kind in the interior of the building to be discerned.

"The front presents the most remarkable architectural skill to be found about the building. The walls were of the most durable kind of limestone; and upwards of three feet thick, of fine hewn stone, laid with the greatest care. There were eleven doorways besides those of the recesses. The finish of the angles, generally, was as smooth as though the material were cut with a sharp knife.

"The ornaments were composed of small square pieces of stone, shaped with infinite skill, and inserted between the mortar and stone with the greatest care and precision. About two-thirds of the ornaments are still remaining upon the façade. The most elaborate were over the centre or main entrance. These have fallen, and now are a heap of ruins at the base. One of them was a figure of a man, with a head-dress of feathers and tassels; part of which still remains, with lines of hieroglyphics underneath. The ground-work of the ornaments is chiefly composed of raised lines, running diagonally, forming diamond or lattice-work, over which are rosettes and stars; and, in bold relief, the beautiful Chinese border.

"From the centre of the building to the recess, at the northern extremity of the building, the ornaments have mostly crumbled off, and are now lying at the base in ruins; and the other parts, contiguous, seem ready to follow the example. The rear of this edifice is more plainly finished; the main part of the centre has fallen.

"Over the principal doorway are the remains of a female figure, in a sitting posture. The hands and legs have fallen. It has a fine head-dress of cap and tassels, and neck ornaments. The waist looks quite natural, and the whole was finely finished. On each side of this figure was hieroglyphical writing. The inner rooms of the centre of the Governor's House still show the places of excavations, made some years ago, by the curate of Ticul." * *

"A moonlight scene from the Governor's House is one of the most enchanting sights I ever witnessed. The moon had risen about half-way up from the horizon, and was now throwing its strong silver light over the whitened façade of *our house*. Castles, palaces, and falling pyramids were distinctly to be traced in the foreground. At a distance, walls and mounds, rising above the green verdure of the land, looked like a multitude of small islands in a calm summer's sea. All was quiet but the chirp of the cricket, or the occasional scream of some night-bird of the wood. It was a scene of natural beauty such as I never have seen realized upon canvass of the artist, or even in the pages of poetry."

Mr. Norman's work contains a sketch of the Maya language, and the latter portion is devoted to speculations on the population of America, and on the history of the remarkable antiquities to be found in different parts of the continent. The Maya language resembles the Chole, a language of Mexico, and is of very remarkable structure, the grammatical forms very much resembling the English, except that suffixes are used. A striking point is the use of auxiliaries with the verbs, a general indication of the descent of a language from one of richer forms. The assumption of what we may call the auxiliary state, is a remarkable and inexplicable philological phenomenon of which the instances are very frequent; and we may mention Anglo-Saxon and English, Hellenic-Greek and Romaic, Persian and modern Persian, Sanskrit and Bengalee. We have neither had time nor opportunity to compare the Maya language with many of the American continent, but we have with the Aymara (Peruvian) some of the Brazilian dialects, the Paraguay Guarani and Abipone and the Californian, and the result is no apparent resemblance with any of the languages but the Aymara. The Brazilian and Guarani are as closely allied as Spanish and Portuguese, but seem to have no points of resemblance with the others, and use affixes instead of suffixes. The Aymara, it is to be observed, is one very extensively spread in Peru, and is spoken by the Canchis, Castas, Collas, Collaguas, Lupacas, Pacases, Carancas, Charcas, and others, being the native language of the Lupacas. This language has been a good deal cultivated by the missionaries, as the Maya has been, and a grammar of Aymara was published at Rome as early as 1603, the first Maya grammar appearing in 1560. The following words seem to show a resemblance between the two languages.

	Maya.	*Aymara.*
Father	hachyum	Auquihana
Mother	hachnaa	tayca
Man	uinic	haquenaca

In construction there is also a considerable resemblance, the pronouns being suffixed to the other words. The following is an example of pronouns in the two languages.

	Maya.	*Aymara.*
My	in	na, ana, nabasa
Ours	ca	cha, cass
His	u	ru
Theirs	an	ana

The general resemblance between the Aymara and the Maya appears in actual observation to be as close as that of two families of the Indo-European languages, but does not extend to general words, only to some of the simple words, and to construction.

Into Mr. Norman's speculations we cannot enter, but we cannot resist observing that the general evidence seems to bear upon the common origin of the civilized races of America, and their relationship to the civilized races of the old world. When we trace the Indo-European languages up to their common stock, we find in the Sanskrit, Zend and Persian types, although many points of resemblance, many points of diversity, and perhaps no greater difference exists between the Japhetic, Semitic, and Hamitic languages, or whatever the classification may ultimately be determined to be. It certainly is the case that although there is a distinct character of the Semitic [1] and Indo-European languages, that points of identity are to be discovered, while among the scattered people of the Pacific ocean, many relics of language are to be found, which may have a relationship with those two great divisions. [2] There is nothing, therefore, to countenance any departure in that respect from the testimony of the sacred records as to the common origin of the several human races. Supposing the American civilized races to have migrated from Iranistan, their route might lay through southern Siberia (in which ancient and extensive monuments are to be found), across the Pacific to the Columbia, by the course of that river to the valley of the Mississipi, thence through Mexico, to the western coast of South America. The circumstance of a race not occupying the whole of a country, is frequently to be found in the migrations of the Indo-European nations. Thus it is questionable if Scandinavia and Ireland were ever occupied by what Mr. Winning calls the Perso-European races, who pushed out the Medo-European races. A subsequent Mongol invasion of the American continent, taking a different route, might have supplanted the civilized population, and extended its settlements in the same way that is familiar to us in the history of Europe. But we must leave such speculations, and wait for the researches and labours of others to reveal that fossil history of America, which will yet be digged from its monuments, and collected from among the tribes of its children, secluded in mountain fastnesses.

Martin Chuzzlewit. By Boz. London: 1843.

It must be confessed that we seem to go altogether out of our way in bestowing any notice on a work of this kind; still, as Mr. Dickens treats the architectural profession rather cavalierly in this new production of his, we feel ourselves called upon to be equally free with him, and must tell him, that, as far as they have yet been shown, both his Mr. Pecksniff and his Tom Pinch are errant caricatures—not only over-drawn, but ill-drawn—fantastic creatures of one who seems to mistake sheer extravagance for imagination. It now looks as if Mr. Dickens had been quite spoilt by success, and accordingly fancies that whatever he writes will be sure to take with the public. So far, he may not be very much in the wrong, for we believe that had "Chuzzlewit" been given to the world without his name, it would have been pronounced "sad stuff." What should be character is only coarse caricature, and is laid on, not with the pencil of a master, but with a *trowel.* Mr. Pecksniff might do for a "Gin-Palace" architect, but for nothing better; and even then his barefaced hypocrisy, as blundering too, as it is barefaced, is perfectly gratuitous, and by no means a professional trait. We may therefore suppose, that such as it is, that character is intended as an individual portrait, the original of which we are quite unacquainted with. At all events, it is a highly disagreeable and absurd one; and wholly destitute of probability. It might be rendered a vehicle for wholesome satire, but not, we fear, by Mr. Dickens, for to say the truth, he appears to know very little either of architecture, or the profession. In fact, he evidently *shirks* the former, otherwise he would have shown up the absurdities of Mr. Pecksniff's own designs, and would have let the public see what arrant humbug and quackery will impose upon it. Humbug, however, is by no means confined to the architectural profession: at the present day there is more than enough of it, on the part of those *critics*, who would fain persuade us that we have got another Henry Fielding in Charles Dickens; which we shall believe when we believe that Tom Moncrieff is a second William Shakspere.—After all, we may be mistaken in one very essential point,—namely, the authorship of the work: inasmuch as it professes not to be written, but merely *edited*, by Boz. Consequently he does not give it to the world as his own, and has probably merely been employed to lick into shape some other person's literary cub.

[1] We may note that we have observed great resemblance between the affixes and suffixes of the Hebrew and Arabic and the Magyar, and in the pronouns generally.

[2] It is curious to observe the wide spread of the roots mira (Sanscrit), sea or water, and ship or skiff,—words perhaps which boast of the most extensive diffusion; and admitting the seat of the human race to be in Iranistan, easily to be accounted for by the neighbourhood of the Euphrates and the Indus, the Persian Gulph, the Arabian and Caspian seas,

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Ancient and Modern Architecture. By M. Jules Gailhabaud. London: Firmin Didot, 1842. Parts 4, 5, 6, and 7.

The interest of this work continues unabated. We find in the numbers before us, the Tower of the Giants at Gozo, Temple of Segesta, St. Vital at Ravenna, the Cathedral of Freyburg, the Certosa at Paira, the Mosques of Cordova, and Ebu Touloun at Cairo, and a Gallery in the Church of the Madeleine at Troyes. The two plates of St. Vital and its details give as good an idea of that remarkable monument as could be desired, and also another remarkable monument of very remote antiquity, the Tower of the Giants, is extensively illustrated. The designs seem, indeed, to be executed with that care which is requisite to give them value, as a work of reference.

The Topographer and Genealogist. Part I. London: J. B. Nichols.

This is a quarterly work, which takes up a good position in a field where much service is to be done. In the first article on the Earls of Lincoln, we recognize a spirit of critical research, which promises to do much good in the weed-abounding field of genealogy; but we should have liked also a more comprehensive grasp of the historical bearings of the subject. The *catalogues raisonnées* of brasses, monuments, and new antiquarian publications, will prove invaluable to the amateur and student, and makes stores of information readily available, which now require unnecessary labour to reach. If this work can but keep pace with the mass of scattered information constantly springing up on the subjects of its research, and present regular digests of them, as digests of cases are supplied to the legal profession, antiquarian and topographical studies will be very much advanced. We may notice a slight clerical error, by some mistake. Mr. Akerman's valuable Glossary of the Wiltshire Dialect has crept under the head of works relating to Yorkshire.

Examples of Encaustic Tiles. Part III. London: J. B. Nichols.

This number contains some examples of heraldic tiles, which perfectly show the applicability of this material for such kind of decoration. It also illustrates a series of wall tiles from Malvern, and the curious tile from Worcestershire, bearing the following inscription here slightly modernized.

> "Think, man, thy life may not aye endure—
> That thou dost thyself, of that thou art sure,
> But that thou keepest, unto thy *factor's* cure, [1]
> And ever it avail thee, it is but adventure. [2]

Mr. Nash reads *executor*, but we should suggest *factor* or *faicteur*, an agent, by which the applicability of the text is equally maintained, and its language better preserved.

BADEN-BADEN.

The new *Trinkhalle*, or Pump-room, by the architect Hubsch, at Baden, is spoken of in terms of very high commendation by a writer in a German periodical. "I consider this building," he says, "to be one of the happiest specimens of architecture that have been produced in our times. Delightfully situated, the structure itself is beautiful in its form and proportions, and unaffectedly expressive in character,—significant in design, and preserving a tasteful medium between unmeaning decoration on the one hand, and bare and dry scantiness of it on the other." The building is raised on a boldly rusticated substructure, and consists of seventeen open arcades, whose flattened arches spring from columns, which last are not according to any particular order, except that their capitals, being foliaged, partake of the Corinthian character; but the columns themselves are of

[1] Care. [2] Chance.

shorter proportions, and the angles of the abacus are cut off so much as to render that member octagonal. The centre consists of five arches, resting on two antæ and four columns, with steps leading up to it, and is crowned by a pediment with a bas-relief by Reich, a young sculptor now rising into celebrity. The merits of the design must, however, be taken entirely upon trust, for there is very little amounting to description in what Ernst Förster says of it. Some particulars that might easily have been stated are passed over altogether, notwithstanding that, for want of them, it is impossible to form any distinct idea of the structure. There is, for instance, not a single dimension given by which we might even guess at its size: nor is it even so much as said whether it is an edifice of any magnitude. We are again quite at a loss to understand whether the "seventeen arches" spoken of belong only to the principal elevation, or not. The "description," in short, is of that kind which, though it may be clear enough to those who have seen either the building itself, or drawings of it, is unintelligible without such additional information,—a very common, but also a particularly provoking, fault.

DREDGING AND DREDGING MACHINES.

[The following communication describes a practice called *radius cutting*, which has been recently introduced into several large dredging operations. In this new process a lateral sweep, or circular motion, is given to the ladder, or bucket frame, which swings upon its upper extremity as a centre, and in its action imitates that of a scythe in mowing,—with this difference, that the scythe only cuts from right to left, whereas the buckets cut both backwards and forwards, which is the meaning of our correspondent when he says the machine cuts in both traverses. According to the old system of working, which our correspondent styles *trench cutting*, the bucket frame has only a vertical motion, the effect of raising or lowering its inferior extremity by means of ropes and sheaves fixed at the bows of the vessel. The machine could only cut right forward in straight lines, and had to be hove up to its work or dropped down from it when the buckets had done their work in the axis of the frame. Our correspondent contends that the zigzag motion from one cutting position—that is, from one trench to the other—is inconvenient, and occasions a loss of power; that the buckets cutting in trenches are very liable to cut in holes where the bottom is already sufficiently deep; and that after the dredging has been executed in parallel lines, there are still ridges left between the trenches which must be worked off by a repetition of the process. At present we are not able to see clearly how the two latter of these objections are obviated by the new system of radius cutting. However, we insert the letter of our correspondent in full, and shall be happy to receive further information as to the working of this system.—ED.]

SIR—Having twice had to make out plans and specifications of new dredging machines for works where I have been an assistant, I have bestowed a good deal of attention on this subject; and recent accidents to masonry where modes of cutting other than dredging have been adopted, have induced me to send you the following remarks on the new system of "Radius cutting," which has been found so successful on one of the largest navigation improvements at present going on.

In the ordinary method of "trench" cutting, the power applied to lead the machine ahead into the cutting, has also to resist the reaction of the buckets: so that in the Dublin machines it was thought worth while to take the power from the engine. In the Clyde boats this process requires a great expense of manual labour, but Mr. Bald has taken the power from the engine in the newest machine[1] (No. 5).

Now, in radius cutting, the chain from the bow of the machine is not wound up while it is cutting, but is only shortened at each return of the machine, which may be described as swinging on that chain just like the "bob" on a pendulum: the machine being led laterally to the cutting by the *side chains*. These side chains are comparatively easy to work, as the reaction of the buckets is mostly against the radius chain.

There is no more difficulty attending the use of these lateral chains in a harbour, or narrow navigation, than in "trench" cutting, where corresponding chains, or "guys," are required to keep the machine in line, and these are necessarily used on both sides at once; whereas these lateral chains are only tightened on one side,—namely, that on which the machine may happen to be traversing; and where it is required to lower them, to allow vessels to pass, they have only to be tightened up till the buckets fill again.

In the old system of working the boat *ahead*, it has to stop when it has cut a trench, come back over the same ground, and be set again to commence cutting another trench; and after the requisite breadth is traversed, the machine must again work over the same breadth, in the same zigzag manner, to cut the "ridges" which were left between the "trenches." This is the most clumsy and unprofitable part of the system, as these ridges yield before the buckets when soft, and stand when hard, causing a continual raising and lowering of the "ladder." Any engineer may satisfy himself of this, by standing to see the soundings at the "well," which are so irregular that half the full work is not performed: and there is no doubt of the immense loss, by the machine cutting in what is termed "holes."

All these evils are greatly reduced by working with a radius chain. The machine cuts in both traverses, and carries the work clean before it. The surface of the bank can be pared to any level, the machine passing over the hollows and cutting only the heights, and so never wasting time by dredging in holes.

There is no loss from taking the machine rapidly over the ground, when such might be required to keep the buckets full; but in the old system there would be a great loss in doing so, and paring only to a certain extent at each run,—for the backing of the machine is a dead loss of time. Yet though this loss is obvious, there might be a greater, from endeavouring to reduce it by keeping the buckets full the whole length of the trench, for then they might get into holes; and if a machine continue to lift quick stuff from a hole which may happen to be near a hard part of the bank, it can do little good, as the hole, if very quick, fills up of itself, or may soon be expected to collect alluvial matter.

Although it may be true, that, to cut or trench a bank in the proper current, will, by changing the currents and eddies, remove it by a natural process; yet, as this is a point so difficult to hit upon, it is generally allowed, that, to get lorge stones and rocks taken up, and to cut the surface fair, is the surest way of reducing a bank, and of leaving it in the condition least liable to "silt up."

It is with these views of the advantages to be derived from the judicious application of machines, that the preceding mode is brought under the consideration of your readers.

There have been great improvements made in the machinery by the practical engineer; but the civil engineer has not made any corresponding advancement in the working of the machine, although it is his right hand instrument. By attention to the working of the machine, much time and expense may be saved, which no improvement in mere construction of the machinery could ever effect. Dredging machines seem just to be put into the hands of their captains and engine-keepers, to make the best of them. And it cannot be doubted that the performance of these machines might be greatly increased by improved application; indeed, the improvements here described go far to prove this, as they effect a saving of at least one-fourth of the power. When men of science bestow due attention on the subject, farther advancement may yet be made, and the dredging machine be found not only by far the most safe and expeditious, but also the cheapest mode of cutting.

The difference of construction in the machine for working on the radius principle is very little, and need only be made at the lower end of the bucket ladder. As the machine is led side-ways to the stuff, the lower "tumbler" has no flanges, as in the ordinary tumbler, on which they are necessary to assist in keeping the buckets from swerving as they are pressed forward; but instead of the flanges there are "snugs" on the tumbler between the chains to keep them on. It would be useless to notice other parts of the construction in this paper, as that is the characteristic difference. The four crab winches usually erected on the deck of a machine serve with a snatch-block to wind the traverse chains.

30, *Hope Street, Glasgow*, W. C., C.E.
21st March, 1843.

[1] No dredging machine is complete unless the work of heaving the vessel ahead be performed by the engine. It is one of the most obvious applications of the steam power by which the machine is worked, and we believe some of the earliest engines—for instance, those on the Caledonian Canal—were so contrived, as to be hove forward by the engine when required.—ED.

BELL ROCK LIGHTHOUSE.—The monthly return from this establishment for February takes notice of a heavy sea upon the rock, from the north-east, on the 14th and three following days, when the spray rose from 70 to 80 feet on the lighthouse tower. On each of these days, says the return, "we felt the building tremble but very little." Various of the travellers or boulder stones upon the rock have been shifted from "Arniston and Ulbster" ledges to the west end of "Hope's" Wharf. The boulders connected with the "Royal Burghs" have also been tossed about; one of these measures nine feet in length.—*Caledonian Mercury*,

ABERYSTWYTH HARBOUR.

Sir—In perusing "Blackford and Imray's Charts and Sailing Directions for St. George's Channel, 2nd ed." lately published, at p. 40 I find an account of this harbour as follows:—"Aberystwyth Harbour is a narrow creek, and not fit for vessels that draw above 9 or 10 feet water, and these must have spring tides to go over the bar." From the following account it will be seen what alterations have taken place through engineering skill, which has completely set aside the above description.

The Harbour of Aberystwyth is situated in the bottom of the Bay of Cardigan, terminated by Bardsey Island on the North, and Strumble Head on the South, and lies about 5 leagues E. N. E. from New Quay, but more immediately between two points of land, the Castle Hill on the North, and Alltwen on the South. Between these two points of land, the Rivers Rhydiol and Ystwyth empty themselves into the sea. Aberystwyth Harbour may be distinguished at some leagues distance by Pen Dinas Hill, which rises steep on the south end, also by the ruinous castle near the town.

The sea coast here about is nearly N.N.E. and S.S.W. by compass bearings; the prevalent winds from the W., and more especially from the W.S.W. produce the heaviest swells; for in that direction the Aberystwyth coast lies exposed to the fury of the Western Ocean.

The Harbour, in its original state, was probably only the mouth of a mountain river, the Rhydiol, which, after a course of about 20 miles through a slate stone soil, falls into the sea. The Rhydiol, like other mountain streams, is subject to sudden and violent floods, or freshes, during rainy seasons, and a great quantity of slate, gravel, and other matter is brought down the river by the effect of these freshes. The foregoing observations equally apply to the River Ystwyth. The Ystwyth having united its waters with the Rhydiol at the entrance of the Harbour, these two rivers maintain one common outfall, through the beach into the sea. The slate gravel brought down the rivers, and the beach that was brought from the southward, accumulated, and being thrown up by the action of the sea, a *bank* or *bar* was formed at low water. This bar offered a constant obstruction to vessels, in their ingress and egress, and often caused great destruction of life and property.

Now to show what engineering has done. In the year 1838, the trustees commenced a substantial new stone pier on the south side of the entrance of the harbour, to protect the harbour from the western gales, and to prevent the beach from accumulating and forming a bar. This pier is now (1843) extended from the beach 260 yards in the direction of SSE and NNW, and as far as is completed, has fully answered their expectation. In the first place, it has stopped the progress of the beach, and deposited the same at the back of the pier. Secondly, it has guided the rivers into a proper channel, by which it has caused a deeper channel to be formed, and removed the bar. Thirdly, instead of 9 or 10 feet water at spring tides, it has now obtained that height or more at the neap tides, and an average of 16 feet at spring tides. Lastly, it has removed that danger to vessels and mariners arriving or sailing or having to wait in the bay during the neap tides, for water to enter the harbour. The portion of the river Rhydiol and the harbour at high water, occupy an area of about 20 acres. On the pier is erected a powerful capstan, supplied with ropes, and a store house; and about 400 yards to seaward off the end of the pier, are moored two large transporting buoys, lying in 4½ fathoms low water spring tides, for vessels to moor to or warp from, and every facility is rendered vessels making or leaving this port, by signals and lights at tide times; it is now considered by all mariners that visit this port to be the best tidal harbour in the principality, when, but a few years since, it was the worst.

Vessels visiting this port can be supplied with every accommodation for repairing, &c., there being two ship-building departments, a rope walk, and sail makers, also bar and block warehouses. The markets are well supplied, and sufficient stores can be obtained.

An Old Subscriber.

Aberystwyth, March 1st, 1843.

STEAM POWER.

Sir—The detailed table of the values of the different degrees of expansion in the engines of the *Great Britain*, which appeared in the March number of this *Journal*, afforded me much pleasure, since they will tend to produce a conviction of the advantages in the minds of owners of steam boats, who might disregard the form in which it has been already advocated in your pages.

In consequence of an inadvertent change of my expressions from "a cubic foot of water *expended as steam*, is equivalent to one horse power per hour," to "the evaporation of a cubic foot of water is equal to one horse power," you appear to have overlooked the limits I intended to apply to the assertion. The words in italics, which had been used in a few lines above as "*expended as steam in the cylinder*," were inserted to exclude the power due to expansive action, as well as the waste, 1st, in blowing off, 2nd, at the safety valve, 3rd, clearance steam, and 4th, cooling. I happened to roughly estimate these losses at 1 lb. of water for an expenditure of 7 lb. of water as "dense steam" doing work in the cylinder, while the communication with the boiler remained open, making the boiler evaporation identical with your assumption; and I feel assured you will grant me permission to refer to this charge of inaccuracy, and to the standard of horse power assumed in my remarks on nominal horse power in the *Nautical Magazine*.

I merely followed Tredgold in the assumption that steam of atmospheric strength will produce 3,600,000 lb. pressure one foot high, and consequently maintain during one hour, a gross power on the piston of 60,000 lb. one foot high; and I apprehend this assertion is equally true, with a slight increase for higher steam, and a slight decrease for steam below the atmosphere for the "*dense steam*" not worked expansively.

As a secondary assertion I added "this gross power is capable of producing 33,000 lb. on the connecting rod," and perhaps in the best engines from 40 to 50 per cent. more, still it is not competent to produce an excess of 75 per cent., and much less an excess of cent. per cent. as due to 14 lb. net pressure, which amounts to 66,000 lb. per minute.

This standard of 60,000 lb. gross pressure I had understood has been occasionally used, or been recommended to be used, by civil engineers in contracts, to prevent disputes with engine makers respecting the excess of power above nominal horse power to be supplied, and it seems a fair mean. Moreover, it meets the difficulties arising from higher steam, and the reduction of power due to expansion, and it is equally applicable to non-condensing engines (the estimate of horse power of these engines seems somewhat undefined).

The employment of an indicator, the value of which you have adverted to, is obviously required in estimates of the above nature; and though well adapted as a standard of comparative power and coal consumption, yet nominal horse power might still be used as a measure of the size of the engine: which seems a good commercial unit, of the same value as the diameter in inches, of the cylinder used in Cornwall, where the loads vary from 5 lb. to 16 lb. per square inch, and the strokes from 2 to 11 per minute in large engines.

Accustomed to refer to the "work performed" or duty, I concur entirely in the appeal to the "work to be done" by the engines of the *Great Britain*, especially as I anticipate the most favourable results from the mode in which the designers of the *Great Britain* have availed themselves of the condition that their capacities increase in a faster ratio than the areas of the midship sections of vessels.

I have the honour to remain, Sir,

March 10th. Your's, obediently,

John S. Enys.

INSTITUTION OF CIVIL ENGINEERS.

Jan. 10.—The President in the Chair.

The business of the meeting was commenced by reading an abstract of Mr. Davison's paper (No. 539) describing the mode adopted for sinking a well at Messrs. Truman, Hanbury, Buxton, and Co.'s Brewery, which was published in the minutes of proceedings of session 1842, p. 192, and the following observations were made.

Mr. Braithwaite described the difference between the method employed in sinking the well for Messrs. Truman and Co., and that for Messrs. Reid and Co. In the former the bore was small, and would therefore only produce as much water as was procured from the veins through which it passed vertically, while the latter, by its larger diameter, permitted lateral galleries to be driven in the direction of the fissures in the chalk: thus forming feeders for the well, and at the same time capacious reservoirs wherein the water accumulated when the pumps were not at work.

He attributed the comparative failure at Messrs. Truman's to errors in the mode of sinking: the length of the cylinders which had been attempted to be forced down was too great, and the lateral pressure had prevented them from reaching the chalk, so that when the pumps were set to work an undue quantity of sand was drawn up with the water, causing a cavity behind the brick-work, which at length fell in. The water having been pumped out to a lower level than was proper, the equilibrium between the water and the sand around the cylinder had been disturbed, and the "blow" of sand had ensued.

The New River Company had been advised to sink a well of sufficient diameter to enable them to excavate lateral galleries, but they had sunk their well in the Hampstead Road, of a small diameter, as described in the paper by Mr. R. W. Mylne, published in the third volume of the transactions of the Institution;[1] and although fissures had fortunately been traversed, which gave an ample supply of water, many of the difficulties encountered would, he contended, have been avoided by adopting the larger diameter, and sinking the cylinders into the chalk, before the pumping was commenced.

The supply of water at Messrs. Reid's well had been sensibly affected by the recent proceedings at the Hampstead Road well, which was now being constantly pumped in order to sink it deeper.

Mr. Davison explained that a bore of small diameter had been adopted, because it was calculated that a supply of water, sufficient for the wants of the brewery, would have been obtained by it. The excavation to within five feet of the chalk was suggested by the sudden dropping of the cylinder. He believed that when (contrary to his express instructions) the level of the water was reduced by pumping to below a given point, the sand from beneath the oyster-bed rushed in to restore the equilibrium within the cylinder, and thus caused the difficulties which he had to contend with.

During the last year the pumps had been at work 1616 hours, in which time 300,000 barrels, or 50,000 tons, of water had been drawn from the well.

Mr. Farey believed that the casualties in well sinking, generally arose from the sources which had been mentioned. Mr. Woolf encountered them when sinking the well at Messrs. Meux' (now Messrs. Reid's) brewery. The pumping up of sand with the water was there carried to such an extent as to cause an accumulation of sediment two feet deep in the liquor back, in 14 days, and ultimately the new well broke into the old one adjoining it.

Mr. Braithwaite explained, that, in the year 1814, the well at Messrs. Meux was pumped "to clear the spring," which caused a cavity of nearly 40 feet deep from the sides of the well, and endangered the stability of the buildings around. Piles were therefore driven to support the upper ground, and upon them the brick steining was carried up. If the cylinders had in the first instance been carried down to the chalk, before the pumping had commenced, this accident would not have occurred.

Mr. Vignoles remarked that the same question, as to the relative merits of boring or sinking, had been discussed at Liverpool, for wells in the red sandstone, and in practice it had universally been found that, by the latter system, the best supply of water had been procured, particularly when side drifts had been made.

Mr. Mylne said that the works at the well in the Hampstead Road, which had been repeatedly stopped from accident, were now resumed as an experiment; the quantity of water obtained was more than could be drawn by a pump 12 inches diameter, 6 feet stroke, making 10 strokes per minute (= 294 gallons per minute). The spring was struck at about 234 feet below the surface of the ground, and when the engine was regularly at work, the water generally stood at within 20 feet from the bottom of the well. He coincided in the opinion of the advantage of a well of large diameter over one of small bore, as it permitted side excavations to be made in search of water. This plan had been pursued with success at Brighton.

Mr. Taylor observed that another of the advantages of the large diameter was, that the proceedings could be watched, and accidents could be more readily remedied; the opinion of all practical miners was, that the large diameter was cheaper, as well as better, than the small bore.

Mr. Clark promised an account and drawings of a well now sinking by him at the Royal Mint. The advantages of a large diameter were manifest to all practical men, particularly when the augur or "miser" was used, as it enabled the operation to be continued without pumping; the cylinder, in lengths of not more than 30 feet each, followed the "miser" down regularly, and as soon as they reached the chalk, the operation was considered safe; and as the "miser" did not excavate more than was due to the area of the cylinder, the equilibrium between the water within and the sand without the cylinder was never disturbed. In a well sunk by him at Messrs. Watney's distillery, the cylinders were 11 feet diameter; the "miser" used was 5 feet diameter, and was turned by twelve men at a time.

Mr. Braithwaite concurred in the advantages of using the "miser;" he invariably employed it, and generally with success.

Mr. Farey believed that the augur or "miser" was first used in this country by the late Mr. Vulliamy,[2] of Pall Mall, for sinking an Artesian well, into which there was an irruption or blow of sand, the effect of which was only overcome by this instrument.

"An Experimental Inquiry as to the Co-efficient of Labouring Force in Overshot Water-wheels, whose diameter is equal to, or exceeds, the total descent due to the fall; and of Water-wheels moving in circular Channels." By Robert Mallett, M. Inst. C. E.

This paper is partly mathematical, and partly experimental. The investigation which it details, the results of which are given in ten tables of experiments, had in view principally to obtain the definite solution of the following questions.

1st. With a given height of fall and head of water, or in other words, a given descent and depth of water in the pentrough, will any diameter of wheel greater than that of the fall give an increase of labouring force (*i. e.* a better effect than the latter), or will a loss of labouring force result by so increasing the diameter?

2nd. When the head of water is necessarily variable, under what conditions will an advantage be obtained by the use of the larger wheel, and what will be the maximum advantage?

3rd. Is any increase of labouring force obtained, by causing the loaded arc of an overshot wheel to revolve in a closely fitting circular race, or conduit? and if so, what is the amount of advantage, and what the conditions for maximum effect?

The author briefly touches upon the accepted theory of water wheels, the experimental researches of Smeaton, and the recent improvements in theory, due to the analytic investigations of German and French engineers.

Smeaton, in his paper on water wheels, read to the Royal Society in May, 1759, and Dr. Robison, in his treatise on water wheels, lay down as a fixed principle, that no advantage can be obtained by making the diameter of an overshot wheel greater than that of the total descent, minus so much as is requisite to give the water, on reaching the wheel, its proper velocity.

The author, however, contends that while the reasoning of the latter is inconclusive, there are some circumstances which are necessarily in favour of the larger wheel, and that conditions may occur in practice, in which it is desirable to use the larger wheel, even at some sacrifice of power; and that hence it is important to ascertain its co-efficient of labouring force, as compared with that of the size assigned by Smeaton for maximum effect.

The author states, first, the general proposition, "that the labouring force ("travail" of French writers), or "mechanical power" of Smeaton, of any machine for transferring the motive power of water "is equal to that of the whole moving power employed—minus the half of the *vis viva* lost by the water on entering the machine, and minus the half of the *vis viva* due to the velocity of the water on quitting it." He deduces from the theory, the following results, coinciding with the conclusions obtained by experiment.

1st. If the portion of the total descent passed through by the water before it reaches the wheel be given, the velocity of the circumference should be one-half that due to this height.

2nd. If the velocity of the circumference be given, the water must descend through such a fraction of the whole fall before reaching the wheel, as will generate the above velocity.

3rd. The maximum of labouring force is greater, as the velocity of the wheel is less; and its limit theoretically approaches that due to the whole fall.

General equations are given, expressing the amount of labouring force in all the conditions considered, and their maxima.

One of the principal advantages of using an overshot wheel greater in diameter than the height of the fall, is the power thus afforded, of rendering available any additional head of water occurring at intervals, from freshes or other causes, by admitting the water upon the wheel at higher levels.

The first course of experiments is dedicated to the determination of the comparative value of two water wheels, one of whose diameter is equal to the whole fall, and the other to the head and fall, or to the total descent; by the head, being in every case understood, the efficient head, or that due to the real velocity of efflux at the shuttle, as determined according to Smeaton's mode of experimenting.

The apparatus employed in this research consisted of two accurately made models of overshot wheels, with curved buckets. These were made of tin plate, the arms being of brass, and the axles of cast iron. Special contrivances were adopted to measure the weight of water which passed through either wheel during each experiment, to preserve the head of water strictly constant, and to determine the number of revolutions, and the speed of the wheels.

One wheel was 25·5 inches diameter, the other, 33 inches diameter. The value of the labouring force was determined directly, by the elevation of known weights to a height, by a silken cord over a pulley; the altitude being read off on a fixed rule placed vertically against a lofty chimney; and in other experiments, relatively by the speed of rotation given to a regulating fly or vane. The depth of the efficient head was 6 inches in all cases.

The weight of water passed through either wheel in one experiment, was always 1000 pounds avoirdupoise.

All the principal results given in the tables accompanying the paper, are the average of five good experiments; from the large scale upon which these were conducted, the accurate construction of the apparatus, and the care bestowed upon the research, which was undertaken with reference to an actual case in the author's professional practice, he is disposed to give much confidence to the results.

The weight of water contained in the loaded arc of each wheel is accurately ascertained, and in the tables which accompany the paper, the results of the several experiments are given at length.

The velocity of the wheels, under different circumstances, is carefully noted and discussed with respect to the maximum force.

The author next ascertains the value of the circular conduits, and states that generally, in round numbers, there is an economy of labouring force, amounting to from 8 to 11 per cent. of the power of the fall, obtained by the use of a conduit to retain the water in the lower part of the buckets of

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[1] Trans. Inst. C. E., vol. iii. p. 229.

[2] Vide *Nicholson's Journal of Philosophy*, vol. ii. p. 266,—"An Account of the means employed to obtain an Overflowing Well at Norland House in 1794," by Benjamin Vulliamy.

an overshot wheel, whose diameter is equal to the fall. The velocity of a water wheel working thus, may vary through a larger range without a material loss of power, and a steady motion is continued to a lower velocity than when it is working in a free race.

The author finally arrives at the following general practical conclusions :—

1st. When the depth of water in the reservoir is invariable, the diameter of the water-wheel should never be greater than the entire height of the fall, less, so much of it as may be requisite to give the water a proper velocity on entering the buckets.

2nd. When the depth of water in the reservoir varies considerably and unavoidably in depth, an advantage may be obtained by applying a larger wheel, dependent upon the extent of fluctuation and ratio in time, that the water is at its highest and lowest levels during a given prolonged period; if this be a ratio of equality in time, there will be no advantage; and hence, in practice, the cases will be rare when any advantage will obtain by the use of an overshot wheel, greater in diameter than the height of fall—minus, the head due to the required velocity of the water reaching the wheel.

3rd. If the level of the water in the reservoir never fall below the mean depth of the reservoir, when at the highest and lowest, and the average depth be between an eighth and a tenth of the height of the fall, then the average labouring force of the large wheel will be greater than that of the small one; and it will of course retain its increased advantage at periods of increased depth of the reservoir.

Dr. Robison's views, therefore, upon this branch of the subject, should, he contends, receive a limitation.

A positive advantage is obtained by the use of the conduit varying with the conditions of the wheel and fall, of nearly 11 per cent. of the total power.

The value increases with the wheel's velocity up to $4\frac{1}{2}$ feet per second, or to 6 feet per second, in large wheels. Hence, he argues, that it is practicable to increase the efficiency of the best overshot wheels, as now usually made, at least 10 per cent. by this application. The only objections urged against the use of the conduit are of a practical character, relating to the difficulty of making it fit close, of repair, &c.; but however these may have applied to the rude workmanship of the older wooden wheels, with wood or stone conduits, they are unimportant, as referring to modern water-wheels made of iron. The conduits may be also made of cast-iron, provided with adjusting screws, and hence of being always kept fitting, readily repaired, and capable of being withdrawn from the circumference of the wheel in time of frost, &c.

The paper is illustrated by a drawing, showing the elevation and partial sections of the experimental apparatus, and a diagram showing the full size of the loaded arc of each model.

Mr. Farey observed, that the result arrived at by the experiments, appeared to correspond nearly with those recorded by Smeaton, who had experimented upon, and used practically both kinds of wheels. The buckets of the model wheels used in the experiments did not appear to be of the best form, and they were entirely filled with water; hence an apparent advantage had been obtained, by the use of the circular conduit to retain the water in the buckets. But that would not be realized in practice, for as the form of the bucket regulated the point at which the water quitted it, and it was the practice of the modern millwrights to make the wheels very broad, in order that the buckets should not be filled to more than one-third of their depth, the circular conduits became less useful, and in fact were now seldom used. Smeaton's practice was, to entirely fill the buckets with water, but he never adhered to the slow velocity of revolution which he recommended theoretically in his paper to the Royal Society.

Mr. Fairbairn had adopted broad wheels with an improved form of bucket, partially filled, and had obtained a more regular motion, particularly at high velocities.

Mr. Farey promised to present to the Institution, a copy of the method of calculation adopted by Smeaton for water-wheels.

Mr. Taylor corroborated Mr. Farey's statement of the advantage of using broad wheels, with the buckets of a fine pitch and partially filled; circular conduits then became unnecessary: this was practised among the millwrights in North Wales with eminent success, and a velocity of six feet per second was given to the wheel.

Mr. Homersham believed that in Smeaton's latter works he increased the velocity of his wheels to six feet per second.

Mr. Rennie gave great credit to the author for the ingenuity of the apparatus with which the experiments were tried, and for the clearness of the tabulated results; but owing to the necessary limited size of the model wheels, he feared the results could not be relied upon for application in practice to large wheels. The experiments of Borda, Bossut, Smeaton, Banks and others, were all liable to the same objection.

The best modern experiments are those by the Franklin Institute, by Poncelet, and by Morin.

The result of these might be taken thus:

Undershot wheels, the ratio of power to effect varied from	0·27 to 0·30
Breast wheels " " " "	0·45 to 0·50
Overshot wheels " " "	0·60 to 0·80
Average " " " "	0·60

The velocity of the old English water-wheels was generally about three feet per second; the American wheels four feet, and the French wheels six feet: this latter speed was now adopted by the best millwrights in England. Mr. Hughes, at Mr. Gott's factory at Leeds, and Mr. Fairbairn, had found advantage from it; the latter also had a particular contrivance for carrying off the air freely from the buckets.

It was important to regulate the thickness of the sheet of water running over the shuttle upon the wheel; four to five inches was found in practice to be the maximum depth allowed.

The object being to utilize the greatest height of fall and the greatest available quantity of water, by means of properly constructed openings and such sluice-gates as were first introduced by the late Mr. Rennie for the breast-wheels constructed by him, instead of penning up the water in a trough, it was made to flow in a sheet of regular thickness over the top of the shuttle, and by a self-regulating apparatus to adjust itself at all times to the height of the water; thus obtaining the advantage of the full height of the fall at its surface, and obviating the necessity for the apparatus proposed by Mr. Mallett.

Mr. Mallett begged to dissent from the validity of the objections which had been made to the practical value of his experiments. With respect to the form of the bucket, that used by him could not, he contended, be called a bad form, although it might be susceptible of improvement; but as the experiments were altogether comparative, it was foreign to the question whether the form was bad or good, the same having been used in both wheels.

As it was shown that a certain relation subsisted between two water wheels with the same total descent, but with different diameters, as to their co-efficient of labouring force, a proportional relation would exist with any worse or better form of bucket. The results considered as absolute measures of effect, being obtained with a form of bucket which approached nearer to the best forms now in use, than did those of Smeaton or any other experimenter, were more applicable to modern practice, and therefore he must consider his results, as not without utility.

With regard to the custom of only partially filling the buckets, it must be remarked that buckets of the best forms begin to spill their contents before arriving at the lowest point of the loaded arc; the partial filling could, therefore, only palliate the evil which the circular conduit was designed to remedy. He must, however, contend that a positive disadvantage attended the partial filling. A permanent loss of fall was produced equal to the distance between the centres of gravity of the fall, and of the empty portions of the top bucket at the moment it had passed the sluice; this distance could be but little varied by the fineness of pitch of the bucket, and depended more upon the depth of the shrouding. That there was a constant loss of labouring force by a practical diminution of the effective leverage, or a reduction in the "moment" of the loaded arc. That as the wheel revolved, the centre of gravity of the fluid contained in each bucket, as it approached the lower portion of the loaded arc, was transferred to a greater distance from the centre of motion even before the contents commenced spilling; but the angular motion of the centre of gravity of any one bucket was at first that due to its distance from the centre of motion of the wheel, or to its radius; and as the radius increased, a greater angular velocity would be acquired by the water which had changed its position on approaching the lower point of the wheel; but this increased velocity was given at the expense of the power of the wheel, and hence a partially filled bucket would, he contended, be always attended with a loss of labouring force. To the last objection, a full bucket was not liable.

From all these reasons, he felt justified in concluding, that the use of the circular conduit was more advantageous than the practice of partially filling the buckets.

With respect to the shuttle delivering the water over the top, where the head of water and the fall were constant, no advantage could be obtained by the use of a wheel greater in diameter than the total descent; it was assumed that this form of shuttle would be used in order always to deliver the water as high as possible upon the periphery of the wheel; but the question was, "If the head be variable, what should be the diameter of the wheel to secure the best effect?" The paper showed that a wheel whose diameter was equal to the total descent, when the head was a maximum, did not always give the greatest average labouring force. The question was therefore independent of the sort of shuttle used; it assumed the power of always admitting the water upon the wheel at the highest point of the total descent, and sought to establish the best relation between the diameter of the wheel and the whole descent when the head alone was variable, according to given conditions. The results of this part of the investigation, therefore, while they admitted the full value of Mr. Rennie's shuttle, went further, and pointed out the limits of its useful application.

He was fully aware of the prejudice which existed against the circular conduit, and once participated in it; but his attention had been forcibly drawn to it in his practice, and having used them very beneficially upon wheels of 40, 50, and 60 horses' power, which he had constructed for mining purposes, he wished to draw the attention of the profession to the consideration of their practical merits when adapted to good wheels.

English Marble.—A bed of variegated marble has been discovered in a limestone quarry, belonging to George Pybus, Esq., of Middleton Tyas, near Richmond, Yorkshire. A small piece has been dressed by a skilful workman; the polish is beautiful, and the marble seems likely to be brought into general use.

THE PYRAMIDS OF GIZEH.

At the Royal Institute of British Architects, on the 6th ultimo, a letter was read from Mr. Perring, containing some remarks on the great Pyramid, accompanied by a model.

"The model is on a scale of 30 ft. in the inch, and represents the pyramid in its original condition,—that is, immediately after the sarcophagus was placed therein, and before the passages were filled with stone blocks closing the entrance. From an examination of the ancient Egyptian cubit now remaining, I deduced the length to be 1·713 English feet, divided into four palms, each of seven digits. This measure, when applied to the pyramids, agrees as closely as to render its correctness certain, and I proceed to mention a few of the more obvious results in the edifice before us. The base covered a square of 448 cubits on each side, which, from a statement of Pliny, I take to have been equal to eight Egyptian jugera, or acres; and this supposition is somewhat confirmed by finding the second pyramid would then cover seven, and the third, one and three quarters of these supposed jugera, and so on with the other pyramids of Egypt. The height of the great pyramid appears to have been 280 cubits, being a proportion of height to side of base of 5 to 8; and I may here mention that several other pyramids have the same proportions. This gives the following ratio on a direct section: As half the base is to the perpendicular height, so is the apotheme, or slant height to the whole base; or for each side it may be thus stated as

Rad : Tang : : Sec : 2 Rad.

"Sir John Herschel having the angles only of the pyramids and their passages before him, gave his decided opinion that they were "not connected with any astronomical fact, and probably adopted for architectural reasons;" and the knowledge of the above proportions will I think lead to the same conclusion; for with the most solid and enduring shape possible, the builders obtained a mathematical symmetry which no other proportions could give. Although this pyramid was nearly 480 feet in perpendicular height of solid masonry, the pressure of the enormous mass is so distributed, that the lower courses have only to sustain about 25,000 lb. on the square foot, whilst the material is equal to at least 1,100,000 lb.; therefore it is evident that the main objects of the architect—viz., stability and eternal duration—were well effected. The inclination of the entrance passage of the great pyramid was regulated by a proportion of 2 to 1: that is, two feet horizontal to one foot perpendicular.

"The same mode of regulating the angles is observable in every instance; thus where inclined blocks were used to cover an apartment, a certain portion of the width of the room was taken for the rise or pitch: as in the queen's chamber, where the rise is a third of the width of the apartment, and also the angle of the air passages leading from the king's chamber to the exterior, have a rise of one perpendicular to two horizontal. From finding, in every case, that the angles were thus regulated, I have come to the conclusion that the Egyptians, at the time of the erection of these mighty monuments, possessed no knowledge of the division of the circle into degrees, but that their angles were regulated by the proportion of base to perpendicular height; in fact, the tangential measure of the angle, and not its abstract measurement. That they learned to divide the circle into degrees at a later period is highly probable, as they were celebrated for their astronomical knowledge.

"In every part of the pyramids evidences of premeditated and careful design are apparent; but my present purpose is to draw attention to the more striking points in the great pyramid only. The situation of the apartments in the pyramid appear to have been regulated as follows—

Height from base (external) to floor of passage of queen's chamber	40 cubits
From the above to floor of king's chamber, or principal apartment	40 "
From the above to top of upper chamber	40 "
From the above to apex of pyramid	160 "
Total	280 cubits

Making 280 cubits in perpendicular height, as above stated. The floor of the subterraneous apartment was also 60 cubits below the base of the pyramid."

ROYAL COMMISSION OF FINE ARTS.

Her Majesty's Commissioners hereby give notice:—

1. That the cartoons or drawings intended for competition, according to the notices published in April and July, 1842, will be exhibited in Westminster Hall, whither they are to be sent between the hours of 10 and 5 on any day, Sunday excepted, during the first week in June next, when agents will be in attendance to receive them; but no drawing will be received after Wednesday, the 7th of June.

2. Each candidate is required to put a motto or mark on the back of his drawing, and to send, together with his drawing, a sealed letter containing his name and address, and having on the outside of its cover a motto or mark similar to that on the back of the drawing. The letters belonging to the drawings to which no premium shall have been awarded will be returned unopened.

3. The title of the subject of each drawing, together with the quotation, if any, to illustrate it, must be affixed either to the back or front of the drawing.

4. Each drawing is to be sent upon, or accompanied by, a stretching-frame; but no ornamental frames in addition to the stretching-frame will be admissible.

5. The artists or their agents may attend to examine the works sent by them, and to re-stretch such drawings as shall have been detached from their stretching-frames and rolled for the convenience of carriage.

6. No drawing will be allowed to be re-touched after having been received, except to repair an injury occasioned by accident, and then only by the artist himself.

7. Every possible care will be taken of the works sent, but in case of injury or loss, the commissioners will not be responsible.

8. All the drawings will be exhibited, and catalogues will be published.

9. The names of the judges appointed to award the premiums will be made known.

By command of the Commissioners,

Whitehall, March 24. C. L. EASTLAKE, Secretary.

THE NEW HOUSES OF PARLIAMENT.

REPORT FROM THE SELECT COMMITTEE.

That the committee have met and considered the subject-matter to them referred, and have examined witnesses, and have come to the following resolution, viz.: That considering the great inconvenience of the present House of Lords, and that such inconvenience will be greatly aggravated by the progress of the new buildings before the commencement of the session of 1844, no delay should take place in the building and preparing the new House of Lords beyond what is absolutely required for the safety of the work; that the architect be directed so to conduct his operations as to secure the occupation of the new House of Lords, with temporary fittings, at the commencement of the session of 1844; that in case the architect in the progress of the work of the new House of Lords shall find that more time will be required in consequence of any apprehension of injurious consequences to the building, he shall report the same to the Commissioners of her Majesty's Woods and Forests, in order that such report may be communicated to this house in due time; that it does not appear to the committee that it is advisable that any alterations in the ventilation of the present House of Lords, which would lead to additional expense, should be adopted; and the committee have directed the minutes of evidence taken before them to be laid before your Lordships.—*March* 13.

A return made to the House of Commons, published 27th ult., states that the total amount already expended for building the new Houses of Parliament is £380,483 10*s.*; the amount voted has been £438,500, and consequently £58,016 10*s.* is in hand unexpended, which will be required for works now in progress of completion. It is estimated that a further sum of £578,424 12*s.* 9*d.* will be required to complete the buildings. The total amount of Mr. Barry's estimate will therefore be £1,016,924 12*s.* 9*d.*, besides what will be required for completing the landing-places, making good the pavings, furniture, and fittings, and for decorations by works of art.

The House of Commons, on the 27th ult., voted an additional grant of £140,000 towards the works.

NEW INVENTIONS AND IMPROVEMENTS.

DREDGE'S SUSPENSION BRIDGE.

THE very economical, simple, and powerful principles of the lever in the construction of bridges, may be illustrated thus. A bridge is two arms united at the ends of the chains, the centre, where weight begins and increases from thence progressively, as the chains increase in magnitude and power to the points of suspension. This is effected by an oblique instead of a vertical connection of the platform to the main chains, which fixes all horizontal force in the horizontal line, and gives to the stability of a bridge the most valuable assistance, as is proved by the numerous bridges already erected upon the principle in various parts of Great Britain.

Its truth may also be easily understood by the following experiments. Cut the chains in the middle and the bridge will stand as firm as ever, there being no strain there; then cut the platform in the middle and it will be separated into two independent brackets, each supported by the chains and the strength of the horizontal line against the abutment. The force required to resist this tendency, is a measure of the power conferred upon the bridge, by reason of the oblique connexion of the horizontal line to the chains, independent of the advantage gained by tapering them. On the other hand, cut the chains of a common bridge at the centre, it will destroy the structure; or cut the platform in the middle and leave the chains entire, then it will be seen that there is no tendency of thrust against the abutments, nor any horizontal power in the platform, and that it is the chains only which sustain the structure. In a chain or rope in a pendent curve this cannot be avoided, but in a bridge which consists of curved and horizontal lines, it is clear that the vertical and horizontal forces should be divided, as it is sufficient for the chains in any bridge, in their position of reduced power, to support themselves, the platform and the transit loads; and, independently, it is very clear that the horizontal force should not be in the chains to facilitate their destruction, but in the horizontal line, where it cannot act in the direction of gravity, but where it is as essentially useful towards the maintenance of the structure, as are the chains themselves. It may be remarked that this system facilitates the manufacture of bridges, out of the cheapest and most durable materials—it enables their strength to be computed as easily as the contents of a block of marble is ascertained—requires but one lamina of timber for the roadways, and presents but little surface of resistance, therefore the wind cannot affect it, nor is any longitudinal trussing required, as in other bridges, whose equilibrium is easily affected by the slightest force, because they rest on their centres, similar to the logan stone.

A. Z.

IMPROVEMENTS IN METAL FOR SHIPS, &c.

Mr. William Fairbairn, of Manchester, engineer, has obtained a patent for "*certain improvements in the construction of metal ships, boats, and other vessels; and in the preparation of metal plates to be used therein.*"—They consist in preparing or rolling the iron intended to be used in the construction of ships and vessels, by forming at each edge, and the whole length of the plate, a raised border,—or, in other words, the plate is made at each side or edge, where the rivets pass through, something like double the thickness of any other part of the plate: one side of the plate being plain, which is to be the outside in the construction of a vessel, the other side having two projecting edges, or borders. The rivet-holes on the plain side of each plate are to be countersunk, so that the head of the rivet may be flat or flush with the face of the plate; and in joining two or more plates together, they are not to overlap each other, as hitherto practised, but the plates are placed with their edges together; and behind the two is placed a metal band, bar, or rib, perforated with a double row of holes, to correspond with the holes in the edge of each plate, and the whole are firmly rivetted together so as to form a water-tight joint; and where greater security or strength is required, the metal bands or bars are made in the form of a T, or with a projection on the back side; by this arrangement the resistance of a vessel in the water will not be so great, and the plates at the parts where the rivets pass through will be equal in strength to any other part of the plate; whereas, in those of ordinary construction, the plates are considerably weakened by making the rivet-holes, as such parts have always been found to give way when the plate itself has remained entire.—*Record of Patents.*

IMPROVEMENTS IN CHIMNIES.

M. Eugene de Varroc, of Bryanstone-street, Portman-square, has obtained a patent for "*apparatus to be applied to chimnies to prevent their taking fire, and for rendering sweeping chimnies unnecessary.*"—This invention relates to the application of reticulated metal surfaces, at the commencement, or near the entrance, of the chimney, in order to prevent the passing of the flame, and also to intercept the soot. The apparatus consists of two cylinders of wire-cloth, one within the other, but so constructed that the surfaces of the two cylinders touch, or are in contact with each other. The inventor prefers to make the cylinders of wire-cloth, having sixty-four holes to the square inch, or closely perforated metal plates may be employed, but such will not be found as useful as wire-cloth. The cylinder, which is mounted upon an axis, is fixed in the chimney, as near the fire as convenient, the flue or chimney being so constructed as to prevent any passage for the smoke but through the double-wire cylinder, the wires forming the reticulate, or open work, of one cylinder, being made to cross those of the other cylinder. By this arrangement the flames and soot will be prevented from passing through the cylinder; but there will be sufficient draught through the cylinder for the fire, and the chimney beyond the apparatus will not be coated with soot, the same being deposited on or about the apparatus, which will require to be brushed off every morning, and, if desired, the cylinder can be turned partially round, so as to present another part of its periphery. A modification of this apparatus, composed of a number of perforated plates, and arranged in a rectangular form, is shown, as being applied to the chimney of a steam-engine boiler; in which case there are brushes constructed for clearing the same occasionally from soot.—*Ibid.*

A FIRE ESCAPE.

A correspondent suggests the following simple plan for a fire escape:—

1st. Two ropes of 40 feet in length, each attached to a small chain also 40 feet in length, the end of each chain armed with a spring hook.

2nd. A stout sack of incombustible material (like the fire-proof dresses), open mouthed, with a metallic rim, about four feet deep, and wide enough to hold two persons, with two spring hooks on the opposite sides of the metallic rim, and connected therewith by a small chain of 9 inches long.

These articles should be brought to the spot on the first alarm of fire by a police constable. One rope and chain should be carried into the house next adjoining on the right of the one on fire, and while the rope is held fast, the chain should be dropt from the upper window till it touches the pavement; and the same should be done with the other rope and chain from the house on the left side; the two chains should then be hooked together by the policemen or neighbours. The escape sack should immediately be attached to the centre of the combined chains, and be rapidly drawn up to any window where a person may appear in danger. The moment the individual has got into the sack, one rope must be eased off, so as to allow the other rope to become perpendicular, when the rescued party may be taken in at a lower window of the neighbouring house, or lowered to the pavement; the rescuers giving the rope a half turn round a bed post, so that the lowering may be effected discreetly. It need scarcely be added, that this operation may be repeated several times in a minute, if there should be more individuals to be rescued. The sack, when manufactured, should be steeped in some solution prepared to resist combustion, and care should be taken that the ropes are not unnecessarily exposed to flame.

FLAX MILL AT CASSANO, IN LOMBARDY.

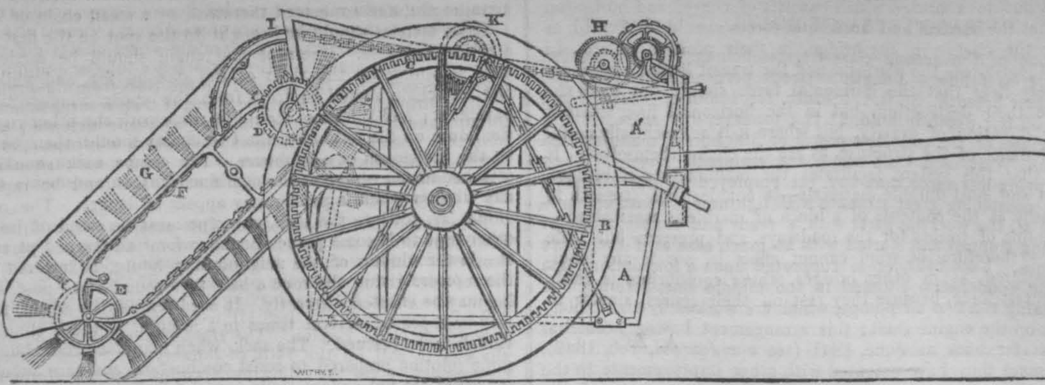
A flax and power loom mill has been established at Cassano, which has excited a good deal of attention in Italy. It belongs to Messrs. Battaglia and Co., and the works were erected by Mr. Albano, C. E., of London. The mill is for flax and hemp, and is divided into three compartments, containing upwards of 8000 spindles, set in motion by a water-wheel worked by the Adda, and 16 ft. in diameter, by 21 ft. or 24 ft. broad. This wheel is of cast iron, except the floats, which are of sheet iron, and the whole weighs 36 tons. To this wheel are attached apparatus for governing the velocity of the machinery, lifting weights to the upper stories, and working fire-engines. In the factory is also included a steam drying apparatus. Altogether the arrangements of the establishment and the adaptation of the machinery are looked upon as conferring great credit on the engineer, and has given great satisfaction to all parties concerned.

THE THAMES TUNNEL.

This important undertaking was opened for foot passengers on the 25th of March last. Thus, after many years of anxiety and difficulties, perhaps without parallel in the history of great Public Works, the practicability of forming a thoroughfare for carriages and foot passengers under a deep navigable river, and without interruption to the navigation, is proved and executed. The obstacles, which have from time to time impeded, and all but stopped the progress of the Tunnel, have been numerous. The work was commenced in 1825, but was stopped in 1828, by an irruption of the Thames. From that time to the spring of 1835 no progress was made. In this year, under the sanction of an Act of Parliament, the Treasury allowed the Exchequer Loan Commissioners to advance, out of the grant voted for Public Works, the money necessary to complete the Tunnel; and it was again commenced and has been continued with few but inevitable interruptions and delays to the present time, when, as the Directors have stated, it is securely completed, and is now thrown open to the Public as a thoroughfare for foot passengers. The two roadways for carriages under the river are also perfectly completed. From its commencement to the present date there have been but 11 years within which the excavation could be carried on. And during this time, for nearly two years or ninety-nine weeks, the works were suspended from circumstances beyond the control of either the Directors or the Engineer. The work has been in fact executed in about 9 years of actual work, at a cost of about £446,000, including property and expenses of every kind, with the particulars of which the Proprietors have been accurately and annually acquainted. The actual Tunnel of 1200 feet was executed in eight years. The Carriage-way descents are now alone wanting to complete the work. They are susceptible of being contracted for in the ordinary way.

The Nelson Monument.—The whole of the leaves, roses, and parts of the Corinthian capital, to be placed on Nelson's monument, Trafalgar-square, have now been cast at the foundry in the Royal Arsenal, Woolwich, with the exception of four volutes. The latter ornaments are most elaborate in their detail, and some idea of the difficulty of making a casting in one piece may be formed, when it is stated that the mould, before it is put together, has to be arranged from about 300 distinct parts, and great doubts are entertained of the artist, Mr. Clark, being able to cast the requisite quantity of metal in the peculiar form of this beautiful and graceful ornament. He is resolved, however, to make the attempt, and confidently anticipates being able to complete the undertaking with from 10 to 13 cwt. of brass. Had the usual mode been adopted the casting could not have been effected with less than about 40 cwt. of metal.

WHITWORTH'S PATENT SWEEPING MACHINE.



This machine, lately brought into operation in the town of Manchester, where it excited a considerable deal of public attention, has lately been introduced into the metropolis, and is now employed in cleaning Regent-street. It is the invention of Mr. Whitworth, of the firm of Messrs. Whitworth and Co., of Manchester, engineers, by whom it has been patented. The principle of the invention consists in employing the rotary motion of locomotive wheels, moved by horse or other power, to raise the loose soil from the surface of the ground and deposit it in a vehicle attached. The apparatus for this purpose is simple in its construction; it consists of a series of brooms (3 ft. wide) suspended from a light frame of wrought iron, hung behind a cart, the body of which is placed near the ground, for greater facility in loading. The draught is easy for two horses, and throughout the process of filling, scarcely a larger amount of force is required than would be necessary to draw the full cart an equal distance.

The following description of the machine by a reference to the accompanying engraving, will explain its action. The cart is constructed with plate iron, and consists of two parts, A, A: the lower part A is suspended to the upper part, and when filled is lowered and replaced with an empty one. To the off-side wheel, B, is attached, on the inside, a cog-wheel, C, which works into a pinion, D, on the end of a shaft the length of the back part of the cart, and fixed thereon are two pullies, 1 ft. diameter and 2 ft. 4 in. apart: two other corresponding pullies, E, are fixed upon a lower shaft, which is suspended to the upper shaft by a wrought iron frame, and over these pulleys pass two endless chains F, to which the brooms G, consisting of 29 rows, each 3 ft. 4 in. long, are attached. It will thus be seen, that when the large wheel of the cart is set in motion, it will, by means of the large spur wheel C, turn the pinion D, and with it the pulleys and the endless chain and brooms that pass over them: and as these brooms come in contact with the road, they sweep the mud up the inclined plane into the bottom part of the cart A. For the purpose of raising the brooms from off the ground, there is an apparatus, H, consisting of an endless screw working into a bevel wheel upon a shaft which passes across the top of the cart: upon this shaft are fixed two pulleys, to which are attached two chains, which pass along the top of the cart and over the quadrants I, at the back, and there fixed to the iron frame of the apparatus,—so that when the endless screw is turned the chains are coiled round the pulleys, and raise the apparatus to any height it may be requisite. For the purpose of removing or emptying the lower portion of the cart, it must be raised to a horizontal position; as this apparatus is raised, it throws itself out of gear by means of a lever attached to a clutch fixed on the end of the pinion shaft D. To the apparatus H there is another motion attached for regulating the pressure of the brooms on the ground, according to the state of the weather and the nature of the surface, consisting of a series of weights in the box in front, suspended to two chains, which pass over pulleys on the axle of a wheel that works into another wheel on the same shaft as the first wheel described of the apparatus H.

There is also another apparatus, K, for raising and lowering the lower part of the cart, consisting of an endless screw working into a cog-wheel, the shaft of which passes across the top of the cart, and on each end are pulleys, round which chains are coiled that suspend the cart on each side.

Provision is made for letting off the water collected in the cart, by means of a pipe, having its interior orifice some inches above the level of the mud after settlement: the cart, when full, is drawn to the side of the street, at some distance from a sewer grid, and the pipe plug being withdrawn, the water flows into the channel. A slight modification of the original form of the machine, by bevelling the cogs of the large spur wheel, C, throws the machinery more to the near side, and enables it to sweep close up to the curb-stone of the foot-pavement; and the hands before required to clean out the gutters are now dispensed with. An indicator, attached to the side of the sweeping apparatus, shows the extent of surface swept during the day, and acts as a useful check on the driver. It also affords the opportunity of hiring horses to work the machine over a given quantity of surface, the rate of hire being per 1000 yards actually swept.—This will be found convenient where parties working the machine do not keep their own horses, and wlil tend to facilitate the introduction of the new system under management of the local authorities.

Where provision cannot be conveniently made in large towns for deposit in yards at proper intervals, the patent machine is constructed of two parts, as above described, viz., an upper, A', carrying the sweeping apparatus, and a lower, A, consisting of a loose box, suspended from the upper, and capable of easy detachment. Each machine having two or more of these boxes, A, may be kept constantly at work, depositing the full box in a suitable place, and taking up an empty box before provided,—a skeleton cart being afterwards employed to convey the loaded boxes to the place of ultimate deposit. No difficulty has been found to arise in the management of the machine by ordinary drivers. It has been worked regularly on every kind of street surface—the round and square set stone,—the Macadamized road,—and the wood pavement; all of which are found in the districts before mentioned. Its peculiar advantage, as applied to wood pavement, in preventing the slippery state of the surface so much complained of, has attracted particular attention, and will, no doubt, tend to facilitate the general introduction of that useful invention. By the use of proper precautions in cleaning and oiling the machine before setting it to work, the friction of the working parts may be materially reduced,—a point of great importance, in reference both to the consumption of horse power and the cost of repairs. The wear of the brooms, which at first was considerable, has been diminished more than one-half, by the action of the regulating weights before mentioned. A product of South America, called by the Portuguese "Piassava," forms an excellent material for the beard of the brooms, having great pliancy and strength combined, and also remarkable degree of durability.

Two machines are advantageously worked together, one a little in advance of the other. Not only is the operation of cleansing a particular street thus effected more rapidly, but the two drivers can occasionally assist each other, and one of them (at higher wages) may exercise a supervision over both machines.

The success of the operation is no less remarkable than its novelty. Proceeding at a moderate speed through the public streets, the cart leaves behind it a well swept tract, which forms a striking contrast with the adjacent ground. Though of the full size of a common cart, it has repeatedly filled itself in the space of six minutes from the principal thoroughfares of Manchester. This fact, while it proves the efficiency of the new apparatus, proves also the necessity of a change in the present system of street cleaning.

Another Great Blast at Dover.—On Wednesday, 1st March, about four o'clock, another great blast took place at the South-eastern Railway works, a little beyond the Rounddown cliff. This blast, as compared with that at the Rounddown (when 18.500 lb. of gunpowder were instantaneously ignited), was comparatively insignificant; but when we mention that 7000 lb. were fired at the present explosion, it will be seen that this insignificance was only comparative. The present operations, like the blast on the 26th January, were conducted by Mr. Cubitt, the engineer-in-chief to the South-eastern Railway, who, with Lieutenant Hutchinson and a number of the directors of the company, were present to-day, witnessing the blast. The effect of this blast has been quite as successful as that which effected the destruction of Rounddown. About 50,000 yards of chalk have been dislodged, ignition being communicated by the voltaic battery. Nine chambers were formed in the cliff, about ninety feet from its top, the object being to blow away the crown of the cliff, to render it safe for the railway carriages to pass on the sea wall under it. Like the explosion on the 26th of January, the present was effected with very little noise and smoke. The instant ignition was communicated the cliffs around trembled, and the immense mass of chalk burst out with a low booming noise, and the ruins were gently, though majestically, thrown down on the beach below; but, instead of, like those of the Rounddown, shoot out into the sea about 1,000 feet, they scarcely, we should say, extended 200 feet in any direction, after reaching the base of the cliff.

STEAM NAVIGATION.

"VIRAGO" STEAM FRIGATE.

The *Virago* is one of the second class frigates belonging to our service. Her dimensions are as follow:—Length between perpendiculars, 180 ft.; keel, 156 ft.; extreme breadth, 36 ft.; breadth for tonnage, 35 ft. 8½ in.; moulded breadth, 35 ft.; depth in hold, 21 ft.; tonnage, 994, M. N. She is fitted with two engines, of the collective power of 300 horses, manufactured by Messrs. Boulton, Watt, and Co., which are eminently novel in their arrangement, occupying less space than any yet employed in her Majesty's navy or otherwise; combining great strength with lightness of construction—facility of access to all the working parts with a ready and simple mode of handling them, being stopped and started with as much ease as if they were intended for river use. Each cylinder is supported upon a foundation plate connected wlth the condensers, situated in the middle line, forming one casting, and containing the two air pumps, which are worked by an auxillary beam from a crank on the engine shaft; this arrangement having been first adopted by them as far back as June, 1841 (see our *Journal*, Feb. 1842), and which arrangement they have patented with other improvements in the oscillating engine. The steam can be expanded at various parts of the stroke, and the valves for that purpose are simple, and work without the usual noise attending those generally employed. There are four boilers, situated close to each other, but having a clear passage round the sides of 18 inches in width. They have stop-valves to each, so that they may be worked separate or together, as occasion may require. There are 16 fire places, and two firing floors—one forward, towards the engines, the other abaft—to which access is afforded by the above mentioned passage of 18 inches. The chimney is surrounded by a water case, from which the boilers are fed with water at nearly a boiling temperature, by which a saving of fuel is effected, and the risk of fire diminished. This plan was originally adopted by this firm shortly after the destruction of the *Prince Regent* by fire in 1817.

The entire of the boilers and steam-chest is covered with felt, two inches in thickness, sewed on to canvas, protected by inch deal with iron tongues, and finally coated with sheet lead to prevent any leak from the deck saturating either the wood or the felt. On each side of the engine and boilers are ranged the coal boxes, extending from bulkhead to bulkhead, and calculated to hold 23 days' consumption; the machinery is there protected from shot by the thickness of the stratum of coal, while the greater part of the engine is considerably below the load line.

The following are some of the principal dimensions of the engines:—Diameter of cylinders, 64¾ in.; length of stroke, 5 ft.; connecting rod, 8 ft.; diameter of paddle wheel, 25 ft.; boards, 8 ft. long in two widths, each 12 in. The entire weight of these engines, boilers, and coal boxes, are 15 tons under that given to the Admiralty in the tender, being little more than 13½ cwt. per horse.

On the 11th instant an experimental trip, for a short distance down the river, was made in the presence of the government engineers, with which we understand they were perfectly satisfied. They will shortly proceed to Chatham, to be fitted with her rigging, &c., when it is presumed she will be forthwith commissioned.

THE "GREAT BRITAIN."—At a meeting of the Proprietors, held last month, the Directors reported that *The Great Britain* is in a very forward state. The frame and hull are complete. The whole of the upper decks, as well as the decks of the forecastle, forecabins, and aftercabins, are laid and caulked; nearly the whole of the state rooms, and other joiner's work, is finished. The forehold, afterhold, and iron coal decks before the boilers and abaft the engines, are nearly finished. The boilers and funnel are fixed in their places, as are the cylinders, condensers, air-pumps, and other weighty parts of the engines. To add to her strength and diminish the apprehension of fire, the decks and partitions of the body of the ship occupied by the engines, &c., will be fitted up in iron. Nearly all the masts and spars are made, and should nothing unforeseen arise, she may be floated out within three months.—[The Directors take good care that the public shall be kept in ignorance of their proceedings as much as possible; for they will not allow any one to inspect the vessel or their works at Bristol, without an order signed by two Directors, and a contribution of 5*s*. towards the sick fund of the workmen. Whoever heard of such a demand? Government allow the public freely to view all the works that are going forward in the public docks, and most of our first engineers will permit any respectable person to visit their works without such an extortionate demand. Lately a professional gentleman applied at the works for admission, and obtained an order from the Managing Director for his admittance, but was told by the porter that he must first pay 5*s*. for his admittance, which he very properly declined to pay, and consequently left in disgust without seeing the vessel.—EDITOR.]

THE "PENELOPE" STEAM FRIGATE.—This large Man-of-War Frigate, which has been lengthened for the purpose of converting it into a first-class steam frigate, has been towed up the river Thames from Chatham to Messrs. Seaward's Wharf at Limehouse, to receive her engines. The engines are constructed on the Gorgon direct action principle, and occupy, comparatively speaking, a very small space for engines of their magnitude. The cylinders are 92 inches diameter, and 7 feet stroke, at 17 strokes per minute, the collective nominal power of the two engines is 680 horses, but she can be worked up to 750 or 800 H. P without incurring the slightest risk. She is fitted with Hall's patent condensers, and an ingenious contrivance for altering the throw of the eccentric rod which works the steam valves, by this contrivance the steam can be expanded to any degree, without the aid of an expansion valve; the air-pumps are of solid brass; there is also an ingenious contrivance for disconnecting the paddle-wheel shafts different to any before adopted. There are four boilers, which are tubular and only 9 feet long; the fire-grate is under the boiler; the fire rises from the grate up the back and returns through the tube to the front, it then returns again over the top to the up-take in the centre of the four boilers, which are placed in pairs, back to back. The chimney funnel is made like a telescope, the upper half slides down. When the vessel is completed, we hope that we shall be able to give a more minute description of the several improvements that we have now but slightly alluded to.

THE HINDOSTAN STEAM-SHIP.—This steamer, it will be remembered, left Southampton on the 24th September for Calcutta. She arrived at Madras on the 20th of December, having, including delays at the various intermediate ports of call, made the passage in 87 days. The time she was under steam was under 60 days, leaving 27 for stoppages and delays. She averaged 200 miles per day. She had 110 passengers to the Mauritius, and landed 25 at Point de Galla, Ceylon. The *Hindostan* proceeded on to Calcutta, whence she was to sail on the 14th of January for Suez. Captain Moresby, the commander, gives the following account of her performance on the voyage from England to India:—"This vessel is uncommonly easy in a head sea and contrary winds; she then shows off her power and good qualities to advantage; she neither rolls nor pitches much, steers well, and is easily managed in turning; sail when set does not increase her speed much, beyond what full power of steam will give her; it has one advantage—sail when set, the vessel requires less steam, therefore a saving of fuel. With a beam swell she seldom rolls at all; when steaming head to sea and wind, is very dry on deck, and does not take in water forward—instance the voyage from Ascension to the Cape of Good Hope against a strong south-east trade wind, she averaged against wind and current 190 miles per day. The north-east monsoon from Ceylon (Point de Galla) to Madras has been strong with a head sea against her and a current of 22 to 24 miles per day against her; yet she has made the distance in three days one hour."

STEAM NAVIGATION.—During the last month, a new steam vessel, fitted with a single engine of 30 horse power, has made several trips up and down the river. She has been built for the Watermen's Steam Packet Company by Mr. David Napier, of Millwall, whose two fast boats, the *Eclipse* and the *Isle of Thanet*, excited great attention on the Ramsgate and Margate station last year. The hull of the new vessel is formed of iron, and has a false bottom, which forms a condenser. The steam passes into the condenser, and cold water under and over it. The machinery occupies a very small space, and the consumption of fuel does not exceed a ton and a half per day. With these very small means, Mr. Napier has succeeded in obtaining an extraordinary speed. Her ordinary speed with the tide is stated to be 18 miles an hour; but she is said to have actually proceeded down the river with the ebb tide at the rate of 19 or 20 miles an hour. In one of her recent trips she performed the distance from London Bridge to Greenwich Hospital, exactly 5 miles, in 16 minutes, and on the following afternoon the same distance was effected in one minute less. She is to be called *Waterman, No. 9*, and is intended to ply between the Adelphi pier and Woolwich.

THE LARGEST STEAM FRIGATE IN THE NAVY.—The Lords Commissioners of the Admiralty last year approved of a plan submitted by Mr. Oliver Lang, Master-shipwright of the Woolwich Dockyard, of a steam frigate on a far larger scale of dimensions and power than any hitherto constructed, and ordered her to be built at Woolwich, and named the *Terrible*. It is now contemplated that this splendid steam frigate shall be built at Deptford Dockyard on the same slip from which the *Worcester* 50 gun ship will shortly be launched. She is to be of the following dimensions:—

	Feet.	Inches.
Length between perdendiculars	226	0
Keel for tonnage	196	10¼
Breadth extreme	42	0
Depth in hold	27	0
Burden in tons	1847	

She is to be supplied with Maudslay and Field's patent double cylinder marine engines of 800 H. P. The cylinders will be 72 inches in diameter, and the erection of the engines alone has been contracted for at the cost, including the boilers, of the large sum of £40,250. The engine-room will be of the following splendid dimensions:—75 ft. long, 38 ft. broad, and 27 ft. deep; and the weight of the engines and requisite gear connected with them will be upwards of 500 tons. The diameter of the paddle-wheels si to be 34 ft. by 13 ft. in breadth. The coal-boxes will contain 800 tons of coals; and altogether this great vessel will far exceed in length and other important points the largest ship-of-the-line ever constructed in this country.—*Times.*

ST. PETERSBURG.—A joint-stock company has been formed for the purpose of establishing a communication by steam boats along the south coast of Lake Ladoga, between Schlüsselburg and Sermar, at the mouth of the Sadir, and along the coast of Friedland, between Schlüsselburg and Sest bol, the boat to touch at Kexholm, and the coasts of Lennowetz and Walgam. At present 800 vessels from Sermur annually navigate the lake.

PORTSMOUTH DOCK-YARD.—The Hon. Captain Corry, one of the Lords of the Admiralty, and Captain Brandreth, of the Royal Engineers, the Civil Engineer to the Admiralty, have visited this dock-yard during the last month upon official business. It is understood that one of the objects they had in view was to ascertain the most eligible position at the north part of the yard to make a basin for steam vessels of the largest class, as the Commissioners of the Admiralty have it in contemplation to make this port, as well as Woolwich, a rendezvous for the equipment of steamers. A site has been selected which it is considered will answer the purpose.

MISCELLANEA.

IMPROVEMENTS IN LIVERPOOL.—Most of our readers are aware of the contemplated alterations in the vicinity known for many years as the New Haymarket, which, being now numbered amongst the things that were, the surrounding straggling houses, timber-yards. &c. are gradually disappearing and giving place to magnificent edifices, which will impress upon strangers entering the town some idea of its immense wealth, extent, and importance. The façade erected at the terminus of the Liverpool and Manchester and Grand Junction Railways, was the first great step towards forwarding this desideratum. The well known skill of Mr. Elmes, of London, having been called into requisition, (whose designs have met with universal approval) we may with becoming pride and pleasure look forward to the completion of the Assize Courts and St. George's Hall within the time stipulated. From the top of St. John's-lane, extending along the west side of Lime-street to Ranelagh-street, a distance of between four hundred and five hundred yards, the entire range of houses, sheds. &c., are to be pulled down, the space widened, and buildings of suitable magnitude erected, which, when accomplished, we may with some degree of pride point to this locality as the centre of attraction in the good old town. Amongst the improvements above alluded to, we have been favoured with an inspection of the plans and elevations for an extensive and first-rate hotel, in the plain Italian style of architecture, which will be situated at the corner of St. John's-lane and Roe-street, the entrance facing the colonnade of the Assize Cousts; and certainly a more desirable situation could not have been selected. The arrangements are to be on the most approved modern scale, and a handsome structure, we have no doubt, will be erected.—*Liverpool Mail.*

LIVERPOOL.—The works at the intended Albert Dock and warehouse, on the west side of the Salthouse Dock, are rapidly advancing. The operation of piling is at present the principal occupation, and for this purpose several steam-engines have been erected on the ground. Excavation is also going on in the centre of the ground, and building in other parts. The entrance into the Salthouse Dock is already formed, and the piling for the sea-wall is advancing. Several hundreds of men are employed on the works, and all seems to go on with great order, expedition, and precision.

THE ROYAL EXCHANGE.—Great progress is now making in placing the sculptured coping above the columns, as well as over the other parts of the building. The transition is more striking on account of the elaborate workmanship being all performed ere the stone is raised, and but a short time is now required with the improved machinery at command to fix it at once in its position.

THE ALPS.—A canal is in the course of formation for the purpose of irrigating the plains of Provence, in the summer months, with the waters which pour down from the Alps. Eight hundred labourers are at work on the canal, on which 1,200,000 francs have already been expended.

CLAUGHTON AND BIRKENHEAD WATERWORKS.—The spirited company connected with this enterprise, which will confer the most invaluable boon on the inhabitants of Birkenhead, having, after immense labour, found abundance of water, the first stone of the works about to be erected was laid by John Jackson, Esq., on Tuesday, 14th March. The engine, which is thirty-horse power, is now in course of completion by Messrs Jones and Potts, of Neston. The buildings are to be erected by Messrs. Walker and Craven.

GRAND RAILWAY JUNCTION.—A contract for forming the junction between the Manchester and Liverpool and the Manchester and Leeds Railways, at Hunt's Bank, has just been made between Mr. Pauling, of Manchester, and the former body. It will be carried on arches some 18 or 20 feet above the level of the streets: its route will be through Salford. Report states that the contract is for something near £70,000, and that the work is to be completed in all in September next. This will unite the towns of Hull and Liverpool by one continuous railway, and prove the means of saving at least ten days in the transit of goods, when contrasted with the canal conveyance.—*Liverpool Mail.*

MACHINERY FOR EXPORTATION.—We understand the machine-makers of Lancashire and Yorkshire are busier than they have been for some years, their orders being principally for the continental market; indeed, ever since the order in council was issued permitting the free exportation of cotton machinery, the trade of machine-making for the use of our foreign rival manufacturers has been more extensive than ever.

MECHANICAL IMPROVEMENTS.—An ingenious application of the common reading-desk to the purposes of newspaper reading has been recently contrived by a Mr. Joseph Schlesinger, an engineer, at Birmingham. It consists of a sliding stand, which supports a light frame fixed at a convenient angle, and capable of holding one or several newspapers by means of an iron cramp, which is opened by a lever. This apparatus will be a perfect luxury for clubs and offices.

LIST OF NEW PATENTS.

(From Messrs. Robertson's List.)

GRANTED IN ENGLAND FROM FEBRUARY 28, TO MARCH 24, 1843.

Six Months allowed for Enrolment, unless otherwise expressed.

John Heathcoat, and Ambrose Brewin, of Tiverton, lace manufacturers for "*improvements in the manufacture of ornamented net or lace.*"—Sealed Feb. 28.

Gottlieb Boccius, of New-road, Shepherd's Bush, for "*improved arrangements and apparatus for the production and distribution of light.*"—Feb. 28.

George Bell, of Dublin, merchant, for "*improvements in machines for drying wheat, malt, corn, and seeds, and for bolting, dressing, and separating flour, meal, and other like substances.*"—March 1.

John Frearson, of Birmingham, machinist, for "*improvements in fastenings for wearing apparel.*"—March 2.

Thomas Simpson, of Birmingham, manufacturer, for "*an improvement in buckles.*"—March 2.

Masta Joscelin Cooke, of Gray's-inn-square, solicitor, for "*improvements in the manufacture of artificial fuel.*"—March 2.

John Keely, the younger, of Nottingham, dyer, and Alexander Alliott, of Lenton, bleacher, for "*improvements in machinery or apparatus for drying or freeing from liquid or moisture, woollen, cotton, silk, and different fibrous materials, and other substances, and also for stretching certain fibrous materials.*" (A communication.)—March 2.

William Walker, of George-yard, Crown-street, Soho, coach-smith, for "*improvements in the manufacture of springs and axles for carriages.*"—March 2.

Charles White, of Noel-street, Islington, engineer, for "*improvements in machinery for raising and forcing fluids.*"—March 2.

Robert Stirling Newall, of Gateshead, Durham, wire-rope manufacturer, for "*improvements in the manufacture of wire-ropes, and in the apparatus and arrangements for the manufacture of the same.*"—March 7.

William Newton, of Chancery-lane, civil engineer, for "*improvements in machinery or apparatus for making pins.*" (A communication.)—March 6.

James Pilbrow, of Tottenham, engineer, for "*improvements in the application of steam, air, and other vapours and gaseous agents to the production of motive power, and in the machinery and apparatus by which the same are effected.*"—March 7.

William Betts, of Ashford, Kent, railway contractor, and William Taylor, of the same place, plumber, for "*improvements in the manufacture of bricks and tiles.*"—March 8.

William Kenworthy, of Blackburn, Lancaster, cotton spinner, for "*improvements in machinery or apparatus called 'beaming or warping machines.'*" March 11.

Charles Chilton, of Gloucester-street, Curtain-road, and Frederick Braithwaite, of the New-road, engineer, for "*improvements in machinery for cutting or splitting wood for fuel and other purposes.*"—March 16.

Arthur Chilver Tupper, of New Burlington-street, Middlesex, gentleman, for "*improvements in the means of applying carpets and other covering to stairs and steps, and in the construction of stairs and steps.*"—March 16.

Alexander Angus Croll, superintendent of the gas-works, Brick-lane, Middlesex, and William Richards, of the same works, mechanical inspector, for "*improvements in the manufacture of gas for the purposes of illumination, and in apparatus used when transmitting and measuring gas or other fluids.*" March 16.

Angier March Perkins, of Great Coram-street, engineer, for "*improvements in the manufacture and melting of iron, which improvements are applicable for evaporating fluids, and disinfecting oils.*"—March 16.

John Thomas Betts, of Smithfield Bars, gentleman, for "*improvements in the manufacture of metal covers for bottles and certain other vessels, and in the manufacture of sheet metal for such purposes.*" (A communication.—March 16.

Frederick Cook Matchett, of Birmingham, manufacturer, for "*improvements in the manufacture of hinges.*"—March 16.

Martyn John Roberts, of Brynycæran, Carmarthen, gentleman, for "*improvements in the composition of ink, blacking, and black paint.*"—March 16.

James Malam, of Huntingdon, gas engineer, for "*improvements in the manufacture of gas retorts, and in the modes of setting gas retorts.*"—March 16.

William Laycock, of Liverpool, merchant, for "*improvements in constructing houses and such like buildings.*"—March 16.

Wakefield Pim, of the Borough of Kingston-upon-Hull, engineer, for "*certain improvements in the construction or formation of buoys or other water marks.*"—March 18.

Alexander Simon Wolcott, of City-terrace, City-road, machinist, and John Johnson, of Manchester, in the county of Lancaster, machinist, for "*improvements in photography, and in the application of the same to the arts*"—March 18.

William Barker, of Manchester, millwright, for "*improvements in the construction of metallic pistons.*"—March 20.

Solomon Rolinson, of Dudley, Worcester, roll-turner, for "*improvements in the manufacture of shot.*"—March 20.

Joseph Needham Taylor, of Chelsea, captain in Her Majesty's navy, and William Henry Smith, of 33, Fitzroy-square, civil engineer, for "*improvements in breakwaters, beacons, and sound-alarms; also in landing or transmitting persons and goods over or through strata or obstructions of any nature, all of which may be used either separately or in combination.*"—March 21.

Andrew Barclay, engineer and brass founder, Kilmarnock, Scotland, for "*improvements in lustres, chandeliers, pendants, and apparatus connected therewith, to be used with gas, oil, and other substances, which invention is also applicable to other purposes.*"—March 24.

Gregory Seale Walters, of Coleman-street, merchant, for "*improvements in the manufacture of chlorine and chlorides, and in obtaining the oxides and peroxides of manganese in the residuary liquids of such manufacture.*" (A communication.)—March 24.

Alfred Hooper Nevill, of Chicester-place, Grays-inn-road, corn dealer, for "*improvements in preparing lentils and other matters for food.*"—March 24.